l. XXVII. July, 1904. No. 1.

MUNICIPAL ENGINEERING

A MONTHLY MAGAZINE

DEVOTED TO THE IMPROVEMENT OF CITIES

PAVING, SEWERAGE, WATERWORKS,
STREET LIGHTING, PARKS, STREET CLEANING,
GARBAGE DISPOSAL, PUBLIC SANITATION, BRIDGES.

PUBLISHED BY
MUNICIPAL ENGINEERING COMPANY
INDIANAPOLIS AND NEW YORK.

Two Dollars Per Year. Single Copies, 25 Cents.

The Auto-Arc

The latest production of the Automatic Incandescent Light Co. Will be ready for delivery August First.

The Automatic Lamps, even the old construction, are rapidly out-stripping everything in their class for open-air lighting.

Literature mailed on application.

Automatic Incandescent Light Co.

Factory, Northboro, Mass.

MUNICIPAL ENGINEERING

VOLUME XXVII JULY, NINETEEN HUNDRED FOUR NUMBER ONE

TO METER OR NOT TO METER.

By J. de Bruyn Kops, C. E., Savannah, Ga.

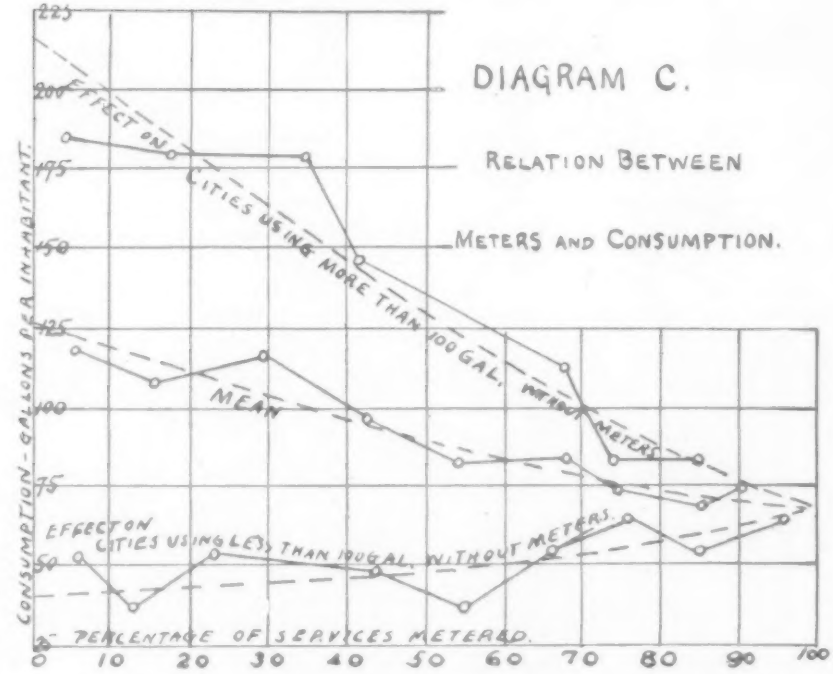
The question of metering or not metering the service pipes of water works plants is one that agitates the minds of water boards and city officials from time to time and, like Banquo's ghost, it will not down. The main point in discussion seems to be economy. The argument on the meter side is that the introduction of meters lessens the consumption by lessening the waste and consequently water plants, having less pumping to do, require less coal and other operating expenses. Also, they can be built on a smaller scale, requiring less outlay at the start. The anti-meter argument is, that by introducing meters you lessen the consumption of water as well as its waste and that to do so is not advisable on sanitary grounds, nor is it economical because in the long run the water board is less strenuous in its tax than the physician and the undertaker. The record of the past should give us facts by which to judge what the future may bring forth.

The number of "Engineering Record" for May 14, 1904, published an article on "Water Consumption at Pittsburg and the Probable Effect of Metering," in which appear some diagrams from data collected by Mr. Morris Knowles, Chief Engineer of the Bureau of Filtration, and it is this article, and particularly one of the diagrams accompanying it, that has given rise to the present article, because the conclusions reached did not seem to be fully warranted from the data, and besides a very obvious matter to the writer was not even mentioned. All data in the present article are taken from the above quoted diagram, which is reproduced here for convenient reference.

Arranging the cities in order of the largest initial consumption of water, we have tables A and B, the first seven columns of which contain the data taken from the diagram. The cities of Allegheny, Bridgeport, Philadelphia and Wheeling, which appear on the diagram, have been omitted from the table, because they showed no increase in the meters used and so were not germane to the present discussion.

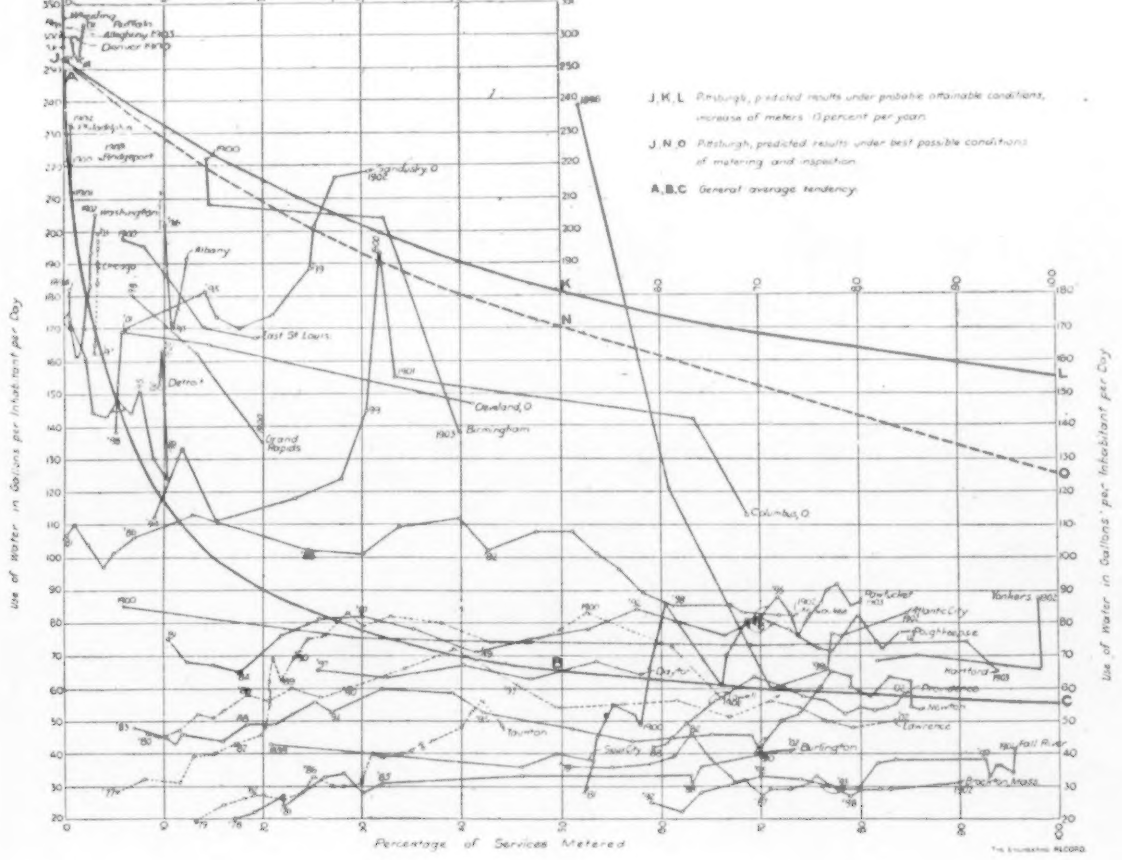
An inspection of the diagram shows by the trend and location of the lines, also by the open space comparatively free from lines between 90 and 100 gallons daily consumption, that some sort of division occurs near this point. Table A has been prepared to show those cities having an initial consumption of water more than 100 gallons, table B showing those with an initial consumption of less than 100 gallons. There are thirteen cities in the first class, and fourteen in the second. The diagram also shows that sometimes the consumption of water increased when the percentage of meters increased, while sometimes it decreased, and so I have placed these two classes in separate columns. Columns 8 and 10 were obtained by subtracting the figures in column 4 from those in column 5; column 9 by subtracting column 7 from column 6 and column 11 by subtracting column 6 from column 7. Now in table A from column 8 and 10, we find that there were eight cities where a decrease in consumption followed an increase in meters and six cities where the reverse was the case, the city of Columbus being in both columns, having zero increase and zero decrease. Now by dividing the total under column 9 by the total under column 8 we find that the decrease for each 1 per cent of meters introduced in those eight cities was 1.63 gallons per inhabitant, while in the six cities an increase of 1 per cent of meters was followed by an increase of one gallon per inhabitant, so that as the average of the class of cities using an initial consumption of more than 100 gallons per inhabitant per day

the introduction of 1 per cent of meters would cause a decrease in the consumption of water of 0.541 gallons per inhabitant, which is a very substantial reduction. The case, however, seems to be entirely different with the cities of an initial consumption of less than 100 gallons per inhabitant. In these cities we find that only four show a decrease while ten show an increase, and while the four cities show a decrease of only 0.151 gallons per inhabitant per 1 per cent of meters introduced, the ten cities show an increase of 0.445 for the same conditions, making the average increase 0.346 gallons per inhabitant for each 1 per cent of meters introduced for the entire fourteen cities.



This difference in the results of metering the two different classes of cities is also clearly shown in diagram C using the percentage of metered services as abscissas, and the gallons per inhabitant as ordinates. In order not to have a confusion of lines, all quantities have been averaged together in parcels, groups of cities with from 1 per cent. to 10 per cent. of metered services and from 11 per cent. to 20 per cent. and from 21 per cent. to 30 per cent., etc., having been added together and divided by the number of such cities in the group. The corresponding quantities of consumption per inhabitant have likewise been averaged and plotted as ordinates to the averages of percentages of metered services used as abscissas. Atlantic City has been left out of these averages, because the figures it presents are so abnormal as to force one to believe that some very unusual leak must have been discovered and stopped, and that the decrease of consumption was not due to the introduction of meters, but to the discovering of the leak, though, of course, the meters may have assisted in the discovery. In fact, an undated pamphlet by Clemens Herschel, entitled "An Attempt to Prove that Thrift in the Operation of Water Works Is More Economical Than Waste," states "Atlantic City probably wastes too much through service pipes. Some years ago it had many small galvanized iron delivery mains, and in about a dozen years after they are laid such pipes leak all over, not in a few places—and the leakage is of a kind that does not show on the surface, hence is not found unless sought for, as will be described later; especially are such leaks not found when the pipes are laid in a sand flat near the ocean, like the one on which Atlantic City is built."

It is to be presumed that Atlantic City discovered these leaks and that the stopping of them is the cause of the drop from 237 gallons per inhabitant to 60 gal-


J, K, L Pittsburgh, predicted results under probable attainable conditions, increase of meters 13 percent per year.
J, N, O Pittsburgh, predicted results under best possible conditions of metering and inspection.
A, B, C General average tendency.
Use of Water in Gallons per Inhabitant per Day
Percentage of Services Metered
Wheeling
Buffalo
Allegheny 1903
Denver 1900
Philadelphia
Bridgeport
Washington
Chicago
Albany
East St. Louis
Detroit
Grand Rapids
Sandusky, O
Cleveland, O
Birmingham
Columbus, O
Taunton
Sioux City
Burlington
Pawtucket
Milwaukee
Atlantic City
Poughkeepsie
Hartford
Providence
Newton
Lawrence
Fall River
Brockton, Mass.
Yonkers 1902
The Engineering Record

lons pe· inhabitant with an increase of meters from 52 per cent to 71 per cent. In view of these circumstances Atlantic City does not seem to present an example of the effect of introducing meters, but rather of the effect of renewing worn out water mains, and so it has been eliminated from the diagram.

The upper full line indicates cities of initial consumption of more than 100 gallons per inhabitant; the lower line those of initial consumption less than 100 gallons; the middle line being the mean. The dotted line in each case shows approximately the average tendency. It will be seen that the effect of metering is different in the two classes and that the average tendency of full metering is to bring the consumption of water in both classes to about 70 gallons per inhabitant.

I think that the following deductions from this diagram are reasonable:

First: When a city has a consumption of less than 70 gallons of water per inhabitant the chances are against securing any reduction by metering.

Second: Where the consumption is more than 70 gallons per inhabitant there is a reasonable hope of reduction by intro-

TABLE A.

1	2	3	4	5	6	7	8	9	10	11
City.	Year when record began.	Year when record ended.	% of meters, first year.	% of meters, last year.	Gals. consumption per inhabitant, first year.	Gals. consumption per inhabitant, last year.	Inc. % of meters when consumption decreased.	Gals. decreased consumption.	Inc. % of meters where consumption increased.	Gals. increased consumption.
1. Buffalo	1895	1901	1	3	300	304	.....	.....	2	4
2. Atlantic City	1896	1903	52	85	238	82	33	156	.....	.....
3. Birmingham	1900	1903	14	40	221	138	26	83	.....	.....
4. East St. Louis	1900	1902	6	19	208	168	13	40	.....	.....
5. Albany	1896	1899	10	12	202	192	2	10	.....	.....
6. Washington	1894	1902	1	3	182	206	.....	.....	2	24
7. Grand Rapids	1898	1900	7	20	180	136	13	44	.....	.....
8. Detroit	1889	1902	1	9	172	152	8	20	.....	.....
9. Sandusky	1894	1902	6	31	170	219	.....	.....	25	49
10. Chicago	1897	1903	2	3	162	200	.....	.....	1	38
11. Cleveland	1898	1903	5	41	138	146	.....	.....	36	8
12. Columbus	1894	1903	9	68	112	112	59	0	59	0
13. Milwaukee	1881	1902	0	74	106	82	74	24	.....	.....
Total for first series							223	377	125	123
Gallons difference per consumer per 1% of meters								1.63	.....	1.00

TABLE B.

1	2	3	4	5	6	7	8	9	10	11
14. Hartford	1900	1903	6	94	86	66	88	20	.....	.....
15. Poughkeepsie	1881	1902	11	85	76	78	.....	.....	74	2
16. Yonkers	1899	1902	82	98	68	86	.....	.....	16	18
17. Dayton	1897	1902	25	58	66	64	33	2	.....	.....
18. Burlington	1883	1902	7	73	48	42	66	6	.....	.....
19. Lawrence	1880	1902	8	83	46	50	.....	.....	75	4
20. Providence	1878	1902	59	84	42	58	.....	.....	25	16
21. Sioux City	1899	1903	21	53	42	38	32	4	.....	.....
22. Fall River	1878	1902	52	96	36	42	.....	.....	44	6
23. Lowell	1877	1902	5	66	28	56	.....	.....	61	28
24. Pawtucket	1881	1903	52	80	28	86	.....	....	28	58
25. Brockton	1892	1902	59	90	24	32	.....	.....	31	8
26. Taunton	1897	1901	13	44	20	48	.....	.....	31	28
27. Newton	1878	1902	17	86	20	54	.....	.....	69	34
Total for second series							219	32	454	202
Gallons difference per consumer per 1% of meters								.151	.....	.445

ducing meters. The farther away from 70 gallons the consumption is the greater the chances for reduction.

Third. That about 70 gallons per inhabitant is the normal consumption in cities without abnormal waste. This, however, is not to be strictly applied, because the size and character of a city, whether resident or manufacturing, has much to do with the consumption.

Fourth. That the introduction of meters does not tend to reduce the legitimate consumption, nor does it reduce the consumption to a point incompatible with perfect sanitary surroundings.

The fact that cities using under 70 gallons of water per inhabitant are increasing their consumption instead of decreasing it under the introduction of meters, I think is explained in this way. The cities that use less than 70 gallons per inhabitant must have small initial waste. As the city grows larger the consumption of water per inhabitant increases because the various uses to which water is applied are greater as shown by Fanning in his work on "Water Supply Engineering." The natural increase in consumption has been more than enough to offset the reduction in waste, which is already small, and consequently the record of consumption has increased.

The reason why a small number of meters installed makes a reduction in the consumption while a larger installation does not increase the reduction may be accounted for as follows:

Consumers have a very general prejudice against the water meter in cities where they have not been generally introduced. The immediate effect, therefore, in establishing a number of meters is to curtail not only the waste, but also the ordinary and natural consumption. In time, however, when the shock of their introduction is over and the consumer sees that his bills are less than they formerly were (and they very frequently are) then he uses the water more freely, and thus the longer the meters are in use the larger the amount used per consumer.

There is a reason, however, for installing meters that is not often advanced, though this has been ably done by Mr. Herschel in the pamphlet already spoken of, and that is the reason of simple justice and equity. Works that supply water do so at an expenditure of say $150.00 to $200.00 per million gallons. The greater the quantity delivered to any one house, the greater the cost of delivery. Now to make a fixed charge against the house instead of per quantity delivered is not expedient because it puts a pecuniary interest on the part of the owner to let the water run to waste. It costs something in trouble and money to keep fixtures in repair, but it costs nothing to allow them to run at full or half tilt under the fixed charge system; nor is it just to the careful owner that he be forced to pay for the negligence of the sloven, and there seems to be no reasonably just way of selling water except as other commodities are sold—viz., by the quantity delivered.

To sum up, it seems to the writer that meters are desirable for the following reasons:

1. They are economical in that they stop waste.

2. They do not reduce the consumption to a point where unsanitary conditions arise.

3. They are the only equitable way of selling the water to consumers.

EFFECT OF HEAT UPON ASPHALTUM IN PAVING MIXTURES

By F. O. Blake, Cincinnati, Ohio.

Asphalt has figured extensively in ancient and modern history and is destined to do much for the future.

It was used in ancient times for many purposes. It composed the mortar of the walls of Nineveh, Babylon and Jerusalem. The Egyptians used it to preserve the bodies of their dead. The Corinthians used it for water-proofing and to line reservoirs and aqueducts. The prehistoric races of South America used it for paving material.

Like the art of tempering copper, that of manipulating asphalt was lost for many centuries. Its modern use in street pavement dates only from 1874. There are now more than 30,000,000 square yards of asphalt pavement laid in the cities of America.

Asphalt is a hydro-carbon of the series between oil and coal. It is of varied consistency; some is liquid, such as maltha, while other varieties are as hard as coal. It is composed of two series of oil, viz.:

petrolene and asphaltine. Petrolene is the tough, rubberlike substance that gives to asphalt its cementitious quality, and its presence determines the value of asphalt for paving purposes. The more fixed the petrolene the greater its value. Volatile petrolene, such as maltha, is not desirable for paving purposes. Asphaltine is the hard, resinous substance of asphalt, and it is that which makes pavement hard and brittle. It has no elasticity, causing pavement to crack when subjected to frost, and soon wears into a dust, blowing and washing away. Any asphalt containing over 25 per cent of asphaltine should not be used for paving purposes. The asphalt produced in the Island of Trinidad, and certain asphalts found in California, contain large percentages of fixed petrolene. These varieties when properly handled produce the best results in pavements. It is the petrolene in an asphalt that gives to a pavement malleability and elasticity—conditions precedent to durability.

The very best grades of asphalt, those containing the greatest percentage of fixed petrolene, can be ruined by overheating. The effect of overheating is to convert the petrolene into asphaltine—that is to say, it is burned or charred—thereby destroying its elasticity. The more fixed the petrolene the greater the degree of heat required to burn it. The best known grades of petrolene convert into asphaltine at 750 degrees, while the lighter or more volatile petrolenes convert at as low a temperature as 400 degrees Fahrenheit. This fact is well known among asphalt experts, and all modern asphalt plants for refining, mixing and laying asphalt are constructed so as to avoid the danger of overheating. We owe a very great deal to such eminent chemists and experts in hydro-carbons as Drs. Bowen, De Smedt, Richardson and Salothe, who have given much earnest effort and have accomplished a great deal for the future success of asphalt paving.

When it is understood that almost all the failures in asphalt paving work are chargeable to overheating, it is plain that one engaged in laying asphalt pavement should understand the exact degree of heat that will convert the petrolene into asphaltine, and should know how to avoid this destructive heat. The converting point of an asphalt should be known and precaution taken to prevent the heat reaching that point. If the converting point is 700 degrees Fahrenheit, then it should not be subjected to over 600 degrees Fahrenheit; if the converting point is as low as 400 degrees Fahrenheit, then the heat should be kept below that point, if good results are to be expected.

An ordinary cherry flame is from 1,100 to 1,200 degrees Fahrenheit, while a white flame is about 2,300 degrees Fahrenheit. Then it is easy to understand the effect of using a smoothing iron that is red hot, or the effect of melting asphalt in a kettle with a direct fire under it, or the effect of mixing sand and asphalt together, with the sand heated to 800 or 1,000 degrees Fahrenheit, or the effect of reheating the pavement with a burner that directs a gasoline or other flame, varying from 1,600 to 2,400 degrees Fahrenheit, on to the pavement, for the purpose of softening the old material to enable quick repair. These things are occurring every day, and people wonder why asphalt pavements are so short lived and so expensive to maintain, and why holes develop here and there in a pavement while other parts of it are perfect. It is always chargeable to overheating.

A pavement may be ruined by overheating in the process of repairing it. Numerous devices have been invented to reheat the old asphalt surface, but most of them have failed, for one cause or another—generally because of the failure of the inventor to appreciate the danger of heat. They frequently destroy more than they repair. One recently developed system of repairing asphalt streets makes it possible to heat the pavement surface to the right temperature without danger of burning. It consists in burning a fire of gas, oil or other suitable fuel in a chamber, through which chamber a current of atmospheric air is caused to pass, and the gaseous products of combustion mix and pass on out with the current of air, the whole being so directed by suitable deflecting hood device as to impinge upon the asphalt street surface to be heated. The quantity of air admitted to the chamber is so regulated and proportioned that when the gaseous products of combustion have become mixed with the air the temperature of the whole volume of gases shall be that best adapted to heating and melting the asphalt without overheating or burning it.

Asphaltum is wholly indestructible by any condition of street traffic. However it may be pounded out of true surface into holes and hummocks, it retains its integrity as material, and all that is needed is to melt and surface it in place. This melting the method referred to efficiently does, without waste or the possible danger of damage to the asphalt material.

WATER SUPPLY OF WORCESTER, MASS.

By F. A. McClure, Civil Engineer.

It was not until Worcester had grown into a town of some two thousand or more inhabitants that an effort was made to conduct water through pipes for the use of its people. The first attempt at procuring water of which record is found was in the year 1798, when, by legislative action, authority was granted to Daniel Goulding to convey water through pipes from a spring on his own land, for the use of himself and neighbors. By this act authority was also given the selectmen to take water from these pipes for the extinguishing of fires, and in this simple way water was brought through pipes into the streets of Worcester for the first time. The supply thus obtained, together with the wells and streams, seems to have answered their purpose many years, for we do not find that action was taken by the town to increase its water supply until the year 1842. By this time the population had grown to about 8,000 people, and the size and importance of its public and other buildings required better fire protection than the wells and cisterns then provided. At this time the town appointed a committee to consider measures for a further supply, and in the year following the selectmen were authorized to purchase what is now known as Bell Pond, as an addition to its water supply. This supply comprised about five acres originally, but was increased to a reservoir of eight acres.

The advantages of a town owning its supply of water were not at that time appreciated, and the selectmen, in their report on the matter, recommended that the town make certain propositions for the construction of an aqueduct. While this measure was being considered the Legislature, upon petition, granted to the inhabitants of the "Center School District" authority to construct and maintain an aqueduct to conduct water from Bell Pond for the use of the town. The school district mentioned comprised the territory in the neighborhood of what is now Thomas-st.

The petitioners being incorporated as the Worcester Aqueduct Company, effected organization in April, 1845, by the choice of a committee of managers, and under certain arrangements between the town and the aqueduct company the work was carried to a completion the same year. The advantages of an increased supply under pressure were soon apparent by its use in the extinguishment of two fires, and so much was its value appreciated that the selectmen, in their annual report, gave it as their opinion "that it will be more for the interest of the town to pay the district to retain the water for security than that it should be sold for profit."

Sime two years later, on the 29th day of February, 1848, Worcester became a city, the act of incorporation providing for the purchase, on behalf of the said city, of all the right, title and interest of the Worcester Aqueduct Company in and to the waters of Bell Pond.

At the first meeting of the City Council under its new charter, measures were taken to procure the rights and property of the water company, which were speedily followed by its purchase.

It was soon manifest that a more generous supply of water was needed, but nothing in the way of advance was done until the year 1854, when an engineer investigated the sources in or around the city from which an additional supply of water might be obtained. The report contained the opinion that the waters of Tatnuck Brook could "not be collected in sufficient quantity by the construction of reservoirs in this valley to supply the city of Worcester, and deemed it unnecessary to cause any survey to be made, either of the extent of country draining into the Tatnuck, or of a route into the city." Incidentally, it may be mentioned that this same stream has been the mainstay of the city's water supply for the past twenty years, and in abundance and quality is unsurpassed. Two large storage reservoirs have been constructed upon the Tatnuck Brook shed, sometimes known and spoken of as the "Holden" supply.

The insufficient supply was exemplified by the exhaustion of Bell Pond. The pumping from springs had to be resorted to. During this period the town pump was doing duty.

It was not until the year 1863, however, that the decisive steps were taken in answer to the people's petition "to procure an abundant supply of water for use of the inhabitants, and for the protection of the city against fire." At this time Worcester had grown to a population of about 28,000 people, only a fraction of whom were supplied with city water. It is stated in the reports of that period that 112 parties, mostly families, were provided with water from private aque-

ducts, and that the city was supplying 146 other parties when the water was not shut off because of an insufficient quantity in the reservoir. The total length of pipe controlled by the city was five and a quarter miles, with 112 hydrants.

The Lynde Brook dam and reservoir, the earliest of the city's sources of supply now in use, was so far completed in the year 1864 as to impound the water for general purposes, and on the 22d day of November was formally dedicated by the city government. Lynde Brook reservoir, when first built, stored, when full, about 230,000,000 gallons of water and covered an area of forty-eight acres. The number of water takers is reported as 175 at that time, but with the added supply this number was rapidly increased.

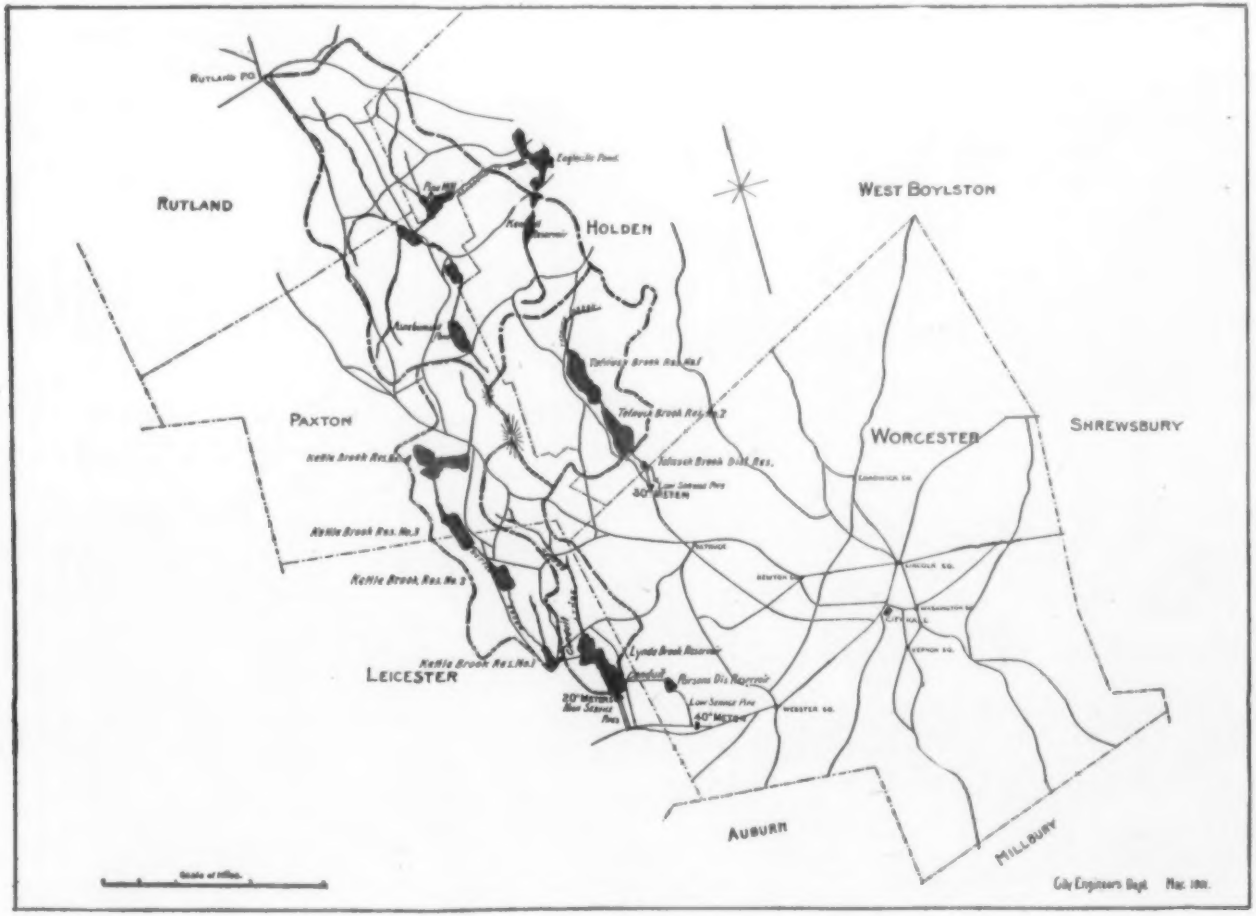
It was soon apparent that a still further storage of water was necessary, and in the year 1870-71 the dam was raised fifteen additional feet, increasing the storage to about 775,000,000 by the use of flashboards. In the meantime, it was evident that the aqueduct could not supply water to certain parts of the city, and as a measure of relief an independent main, utilizing the entire head from Lynde Brook reservoir, was laid and completed in the year 1873. This was the first introduction of what is known as our high service supply, and, with some improvements, is today our only means of furnishing water to the surrounding hills. An ordinance establishing water rates and the beginning of our meter system were important features settled upon during this period. The question of further supply seems to have been an ever-present one for within three years from the time the Lynde Brook dam was raised the city water committee advised the taking of Kettle Brook, and considered the advisability of taking North Pond as an additional source.

It was reported in the year 1874 that the daily consumption of water amounted to 3,000,000 gallons, and that the number of takers was 36,000 people. This would make a daily rate of eighty-three gallons a person, something considerably above the rate in use today. In the report of the city engineer of the same date it was stated that "a partial examination of Tatnuck Brook showed that its capacity as a source of supply may have been underrated" and suggested more extended surveys to determine its value. The following year Henshaw Pond and the Tatnuck Brook were surveyed and examined, and a report giving the results of the surveys was made to the City Council. No steps beyond that of investigation were taken, however, although the water committee of that year said in their report "that with more than a usual rainfall our only reservoir has not been filled for more than fifteen months, should excite apprehension, and should be kept prominently before the Council."

The year 1875 brought added difficulties by the discovery of increased leakage through the Lynde Brook reservoir embankment, in the vicinity of the "pipe arch." The leak, while of considerable volume, does not appear to have occasioned much alarm, for we find that in the following March the reservoir was not only allowed to fill, but that the water was permitted to overtop twelve-inch flashboards in addition. Five days later, or on March 30, the dam was breached, and the city, with a population of 50,000 people, was in dire necessity for water. Without going into the details of the trials and anxieties of the next few months, it is only necessary to add that the dam was immediately rebuilt, and so far advanced before the season was gone as to be of partial service.

Due to the increased use of meters, the daily consumption of water appears to have been considerably reduced, and except to investigate and report upon possible sources of supply, little was done until the year 1881, when legislative authority was procured to take the waters of Tatnuck Brook for the city's use. The low state of the reservoir during the previous months seems to have hastened this action, for we find in the report of the water commissioner for the year at one time "only 18,000,000 gallons or six days' supply, at 3,000,000 gallons per day, could be drawn." The boilers and pumps that were erected at Coes Pond, which had been used in previous times of stress, were overhauled and put in order to run, but a copious rainfall averted the necessity for using them at that time. The following year a shortage of water was again imminent, only to be followed a year later by actual failure. It was during this period of trial, or the season of 1883, that the Tatnuck Brook was added to the city's water supply, and the dam upon that stream was strengthened and made suitable for its new service. Due to the rapid growth of the city, it was soon apparent that additional storage was required, but the recommendations for this work were not heeded, however, until the year 1892, when the storage capacity of the Tatnuck Brook reservoir was increased twofold.

It is interesting to observe that during the nine years previous to this work the population had grown from 65,000 to 90,000



MAP OF WORCESTER, MASS., WATER SHED.

people. The effect of the increase in population was soon felt upon the high service supply, and in the two years after the work upon Tatnuck Brook had been completed the Lynde Brook reservoir failed, making necessary the procuring of a temporary supply from Kettle Brook. This was followed in the year 1805 by the permanent taking of Kettle Brook by the city and the immediate building of a conduit to divert its waters into the Lynde Brook reservoir. Since the taking of Kettle Brook there has been a gradual development of all the sources of supply, and today there exist in the general system seven storage reservoirs and two smaller basins used as distributers.

During the fifty-odd years since the city controlled its water supply, the storage capacity of the reservoirs has increased from 30,000,000 to 2,540,000,000 of gallons, and the number of water takers has advanced from 258 to 122,286. The distribution system has increased from five and a quarter miles to 185 miles of main pipe, and the number of hydrants from 112 to 1,902.

The use of water has become more general than formerly, and is employed for a variety of purposes that were not in practice during the earlier days, but there is greater economy in the strictly domestic consumption of water than was the case many years ago. This is due entirely to the excellent practice of placing meters on most of the pipes, but the record is not as good as it should be, because of the amount of unmetered water that is used. This is largely due to continuing an old practice of extending fire pipes wherever asked for, without being guarded by meters. Attention has been called to this condition from time to time, and from tests made by the water department it has been determined that improper use of water, in considerable volume, is being made in certain localities. The water for street sprinkling is also supplied without revenue to the city.

Since the year 1895 all the water entering the aqueducts has been measured, which has enabled us to keep constantly informed of the amount that is daily consumed. The following table will show to what an extent the consumption of water has increased during the past eight years.

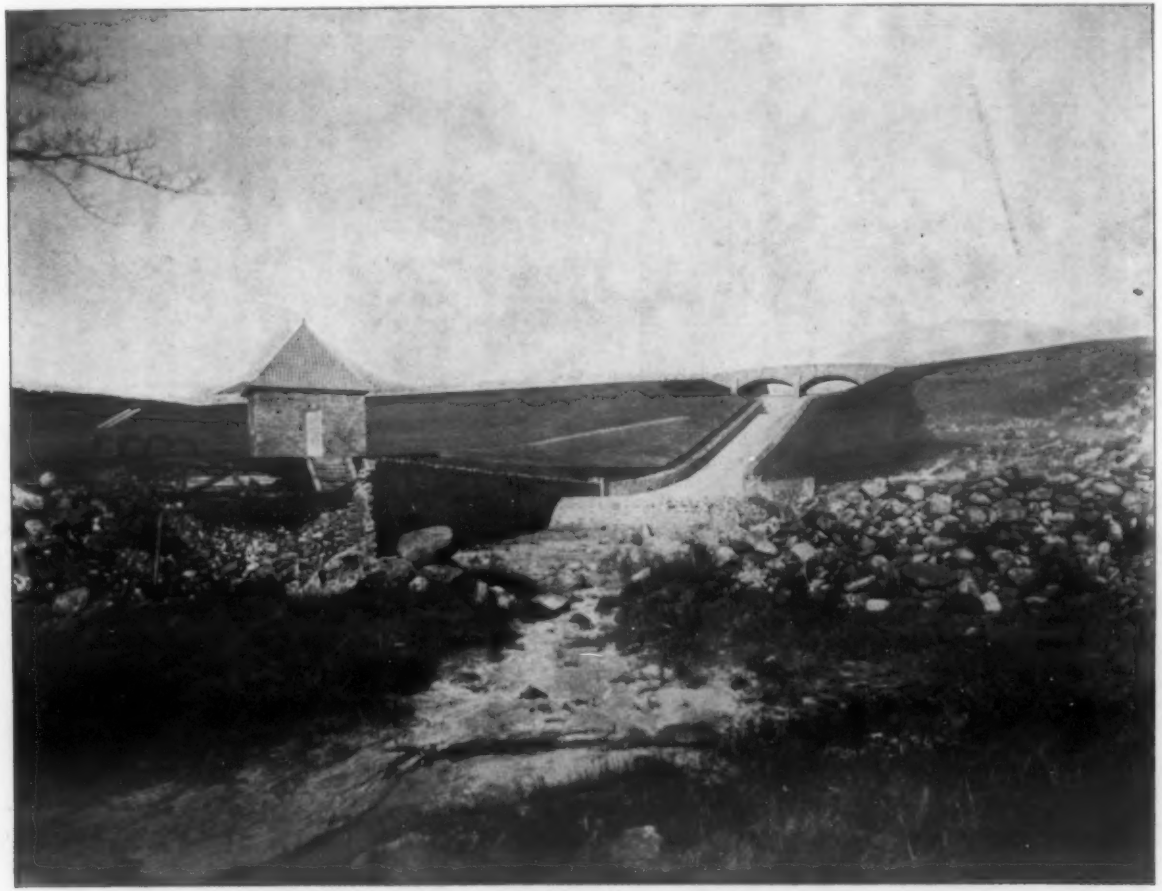
Year.	No. of water takers.	Av. Daily Consumption in Gallons. Total.	Av. daily Consumption in Gallons Per cap.
1896	100,586	6,125,630	60.9
1897	103,702	6,083,016	58.6
1898	105,963	6,795,578	64.1
1899	110,773	7,632,428	68.9
1900	113,217	8,152,373	72.0
1901	116,064	9,013,785	77.6
1902	119,331	8,211,878	68.8
1903	122,286	9,687,173	79.2

During the eight years given the number of water takers has increased 21.57 per cent, while the consumption of water has increased 58.1 per cent.

I think it has been the history of many cities that the increase in population is followed by an increase in the rate of consumption of water, but in this city, where the use of meters is so general, I do not attribute the cause altogether to the additions to the system, but in a great measure to the unmetered fire pipes to which I have referred. While the amount of water consumed may appear large for a community like ours, it is, nevertheless, a moderate and economical use, and Worcester has the distinction of being one of the few cities in the United States that economizes in the use of its public water supply. It may be of interest, and perhaps I ought to further explain that the rate of consumption given in the table is for the total amount of water consumed for all purposes, a considerable part of which is used for other than strictly domestic convenience. The rate for household uses averaged last year but fourteen gallons to the person. The amount of water used in different localities about the city also varies very much, and ranges from about twenty-five gallons to the person in the better residential parts to less than ten gallons to the person in dwellings of the poorer class.

In the manipulation of the reservoirs prior to 1897 there was no way to regulate the flow of water into the low service pipes, so that one source of the supply should not be drawn upon beyond its proper quota to the daily consumption. At that time a new distributing basin was built in the Parsons Brook valley, with a new conduit through which the Lynde and Kettle Brook reservoirs should supply their proper amount of water for the low service use. This distributing basin was constructed at an elevation about sixty feet higher than its corresponding reservoir on the Tatnuck Brook, and on the conduit leading to the city were placed regulating valves, by which the normal pressure could be increased or diminished at pleasure. By utilizing a portion of this difference in pressure, the water from the Parsons reservoir can be forced into the city, and, on the other hand, if the pressure is reduced, the water from the Tatnuck system enters the conduits more freely. This arrangement provides an absolute control of the different systems on the low service supply and in connection with the Venturi meters, which are placed on all the reservoir mains, furnishes both the requisite knowledge and means for intelligent operation of the system.

With regard to the total supply of water



OVERFLOW OF TATNUCK RESERVOIR WORCESTER WATER WORKS.

as it stands today, the situation is not as satisfactory, in my judgment, as it should be. We have, all told, a net catchment area of about eleven and one-half square miles, with a total storage of 2,540,000,000 gallons. Under the ordinary conditions there is no occasion for anxiety, but it is the extraordinary conditions that must be provided for, and which put a very different phase upon the question. Very few people, indeed, give any thought to the water supply further than to go to the tap and draw whatever amount they desire, so long as the quality holds good and there is no restriction in its use. They who have occasion to view the several storage reservoirs, and observe their seemingly generous capacities, often wonder what possible need there can be for such a provision. They frequently fail to appreciate the reduced amount of water that may be expected in periods of low rainfall, and that the consumption must be largely obtained from the storage when such condition exists. Some of our catchment areas are small, and when we fail to get the ordinary precipitation of rain the brooks dry up, and oftentimes the best of them do not furnish sufficient water to provide for the evaporation on the water surfaces. When we consider that during such periods the amount of the run-off often falls below one-half of the amount of water collected in an average year, it will readily be seen that if failure is to be guarded against a generous storage is a necessity.

These storage basins are the regulators, and are built for the very purpose of collecting and storing the water for use when little or nothing may be obtained from the streams. The amount of storage that should be given a catchment area is also one of limit, and this is another feature that often appeals to the visual notice of those who may visit the reservoirs in times of freshet. If water is being spilled or wasted at such a time many naturally infer that the dam should be raised, that little or no water may escape. Let me say that if such a course was to be pursued, there would be periods of many years that the reservoirs would be below high water mark, with a consequent injury to the quality of the water by reason of the growth of vegetation on the exposed surfaces. This is due to the unequal distribution of the rainfall, and for this reason the storage should be so proportioned that the reservoirs should not fail to fill for too long a period at a time. Our own reservoirs are rather overdeveloped in this respect, as they are designed with the expectation of being below high water mark for a period exceeding two years, which is a sufficient length of time to cause considerable injury.

I believe our several sources of supply are developed to all that should be expected of them, with due regard to the quality of water to be desired, and therefore am of the opinion that to provide for the rapid and expected growth of the city, an additional catchment area should be added at once. The city has been greatly favored by having at its very doors excellent water sheds, so situated as to give one of the finest gravity systems to be found. Our high service supply is something that causes wonderment amongst those conversant with water supply systems, and fortunately there are still further additions that can be made without departing from the method of gravity.—The Worcester Magazine.

SOME FEATURES OF THE WATER WORKS OF MADISON, WIS.

In the number of Municipal Engineering for September, 1903, vol. xxv, p. 162, was given a description of the installation of a Wood propeller pump for raising water from a deep well for increasing the water supply of the city of Madison, Wis. The pump consists of a series of propeller blades set at intervals of three to five feet along a shaft in the well tube, in this case about 120 feet long. It is run by electricity at a speed of about 1,200 revolutions a minute.

The pump described is located 3,990 feet from the storage basin at the pump house and must raise water about eighty feet in the well and force it through a 12-inch main against a head of twenty-six feet. The propeller shaft rests on a ball bearing at the bottom, on which the combined pressure of shaft, water lift and resistance is said to be about 3,630 pounds. As a result, the bearing must be replaced in from one to ten days, according to the duty required of the pump.

Another 7-inch pump of similar design put into the Blount-st. well during the past year, is 1,200 feet from the pumping station, of smaller dimensions and at present under less head. The ball-bearings of the shaft have therefore given better satisfaction.

Notwithstanding several difficulties in

MADISON, WIS., PUMPING STATION, FRONT VIEW.

addition to the trouble with bearings, the propeller pumps are declared to be successful and all the difficulties have been overcome except the one, which is now the subject of experiment. One of the accompanying views shows the surface end of the new pump with its motor.

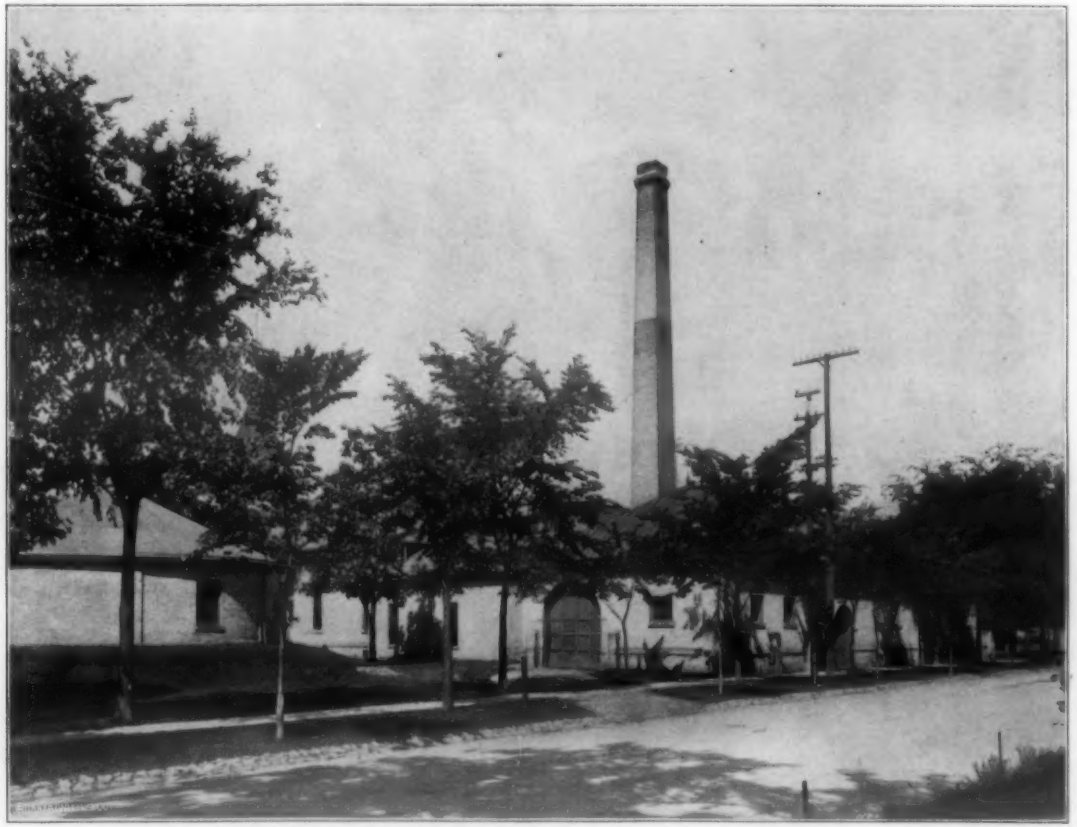
The electricity to operate the pumps is supplied by a 50 kw. generator which is operated by a Reynolds-Corliss engine formerly used to drive a pumping engine now discarded. One of the accompanying views shows the installation.

The value of the propellor pumps is indicated by the statement that the wells when operated by suction, had a capacity of 125 gallons a minute, the level of still-water being about 4 feet below the ground surface. The first 8-inch propeller pumps at a speed of 1,200 revolutions pumps 750 gallons a minute, with a total lift of 80 to 100 feet. The second, 7-inch, pump lifts water 70 to 80 feet and probably has a capacity of 500 gallons a minute or more. Efficiency tests of the pumps have not yet been made. The results of them will be awaited with interest. The cost of installing the two pumps, including the necessary rebuilding, housing, pole and wire line is $6,899.60. This also includes some experiments on new bearings for the pump shaft.

Madison seems to be a place in which the introduction of meters has not resulted in the decrease in consumption per capita of population. This does not show in the tabular statement in the last report, for the consumption per capita is there estimated not on the actual amount of water pumped to consumers, but deductions are made for leakage in pipes and joints and then an arbitrary reduction is made. Over 90 per cent of the services are metered, and the consumption of water as shown by the meter records is 20½ gallons per consumer or 20 gallons per inhabitant. Even with the deductions for leakage, referred to, the total consumption per capita is 64 gallons, according to one statement in the report, or 60 gallons according to the figures in the table of consumption for a series of years. It is evident from these data that the major part of the use of water in the city is for public purposes, and the report names sprinkling of streets and lawns, sewer flushing, sewage pumping, waste in public buildings, running hydrants to prevent freezing. The city belongs in the class of cities whose initial consumption is less than 100 gallons, in Mr. Kops's article on meters, elsewhere in this number, and, as shown by him, is approximately 70 gallons consumption per capita.

According to the recommendations of the Water Commissioners last year, the city has levied a tax to pay the water department for water used for public purposes, and the rates for private use of water will be reduced very nearly to correspond. This is eminently proper, especially since the city and the water department are using and wasting about twice as much water as the private consumer.

Two of the accompanying views show the pumping station as enlarged for new machinery. We are indebted to John B. Heim, superintendent of the plant for the use of these photographs, and to his last annual report for the data in this article.



MADISON, WIS., PUMPING STATION, REAR VIEW.

EDITORIAL COMMENT

The Architect and Concrete Construction.

Sewage Disposal and the Septic Tank.

The Water Meter Question.

THE ARCHITECT AND CONCRETE CONSTRUCTION.

In this country the use of concrete for buildings is so new that the architectural profession has not yet fully adopted it as a suitable material for all the parts of a building to which it is really adapted. This is not true in foreign countries, especially in those in which the German language is spoken, and when the natural and proper conservatism of the architect has finally permitted his approval of the new material, its use will spread rapidly in this country also. Notwithstanding the marvellously rapid development of the cement trade in this country we still use scarcely half the Portland cement per capita which Germany consumes and the total consumption is as yet less.

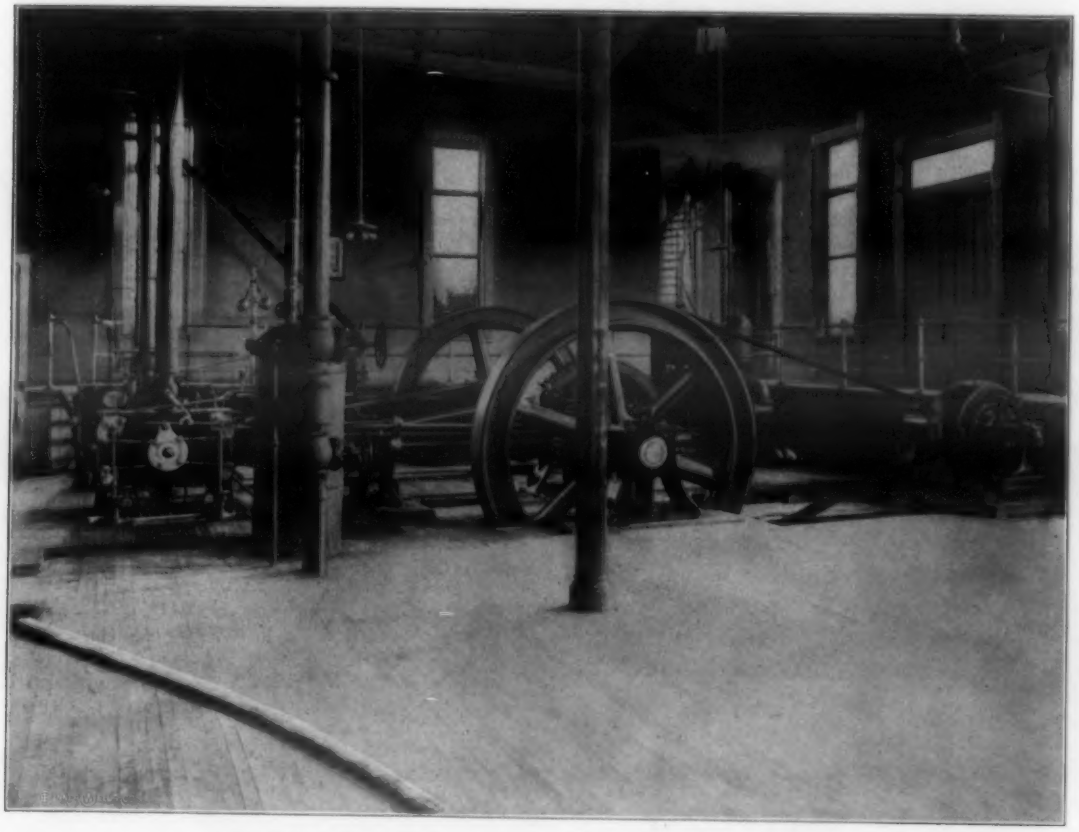
The successful use of cement and concrete in engineering structures, the evident superiority of good concrete in strength and durability, its comparative cheapness and its adaptability to all uses, conditions and situations, lead the progressive capitalist or builder to ask why so valuable material cannot be used in architectural structures as well as in engineering construction?

There is but one answer to this question, it can be so used, and it is the province of the progressive architect to take up the new material and by his scientific and artistic treatment of it to make its use successful. Thus far, but little has been done by professional architects to adapt cement and concrete to any but the most utilitarian uses in a building. Foundations, cellar walls, sidewalks, vaults, inside walls, floors, roofs, have been made of concrete with more or less success, according to the engineering or mechanical ability of the designer and constructor. A list of failures from the attempts of ignorant men to use a material which is new to them is given elsewhere in this number. Not all these failures are to be attributed to the newness of the material, however, for we always have "jerry" builders with us and we always have men who think they can save an architect's fees, and so we always have failures of buildings, without any stigma upon the materials of which they are composed.

But these uses of cement and concrete are now sufficiently common to have demonstrated the value of the material and the attacks of interested promoters of other materials have an effect which is limited in extent and ultimately reacts to the benefit of what is maliciously maligned.

The time has now come for a general extension of the use of concrete for the construction of all parts of structures for which it is adapted, and for the recognition of the fact that there are very few structures for which it is not adapted. The delay of architects of ability and reputation in investigating and guiding the development of the new methods of construction has had its result in forcing those who are mainly interested in cheapness of construction to make their experiments in a wholly inadequate manner and to bring out undeveloped, hap-hazard architectural forms and methods which serve to show their limitations on the lower side and what should not be attempted, an occasional fortunate design giving some idea of the possibilities which lie in the new methods of construction which the new materials call for.

This blind and unguided feeling after the truth, which is clearly recognized, but the way to which is not clear to the untrained mind, has resulted perhaps in the formation of prejudices in the minds of those whose interests are elsewhere, whose time is taken up with other things, who are fixed in the old ways, or who can see only what is on the surface and, since that is not satisfactory can see no possibility of producing something which will be satisfactory. Thus large areas of concrete without joint have made some believe that no concrete surface can be made without cracking. Concrete blocks of a fixed size have made some condemn block construction because it was claimed that the material must fit the architecture and the architect should not be required to make his designs to fit the material. Bad surfaces



ELECTRIC GENERATOR IN PUMPING STATION, MADISON, WIS.

have caused some to declare that durable, handsome, perfect surfaces are impossible in concrete or cement. Execrable limitations of stone, brick or other building materials have caused some to condemn cement as an imitative material which is always a failure.

These are but incidents in the development of the use of this material which are the product of the crude methods used under the conditions forced upon the building trades, partly by the conservatism of architects in taking hold of it and partly by the remarkably successful and rapid distribution of the little knowledge of first value actually gained, which makes the work to be done many times what the few good men in the business of designing are able to take care of.

Observation of the errors made by incompetent or ignorant constructors and owners makes many architects slow to prepare plans for ony work which they are not to superintend personally. This is a laudable caution, but the actual manipulation of concrete is less difficult than that of brick and far less than that of stone, if there is expert direction, and efficient inspection is no more necessary with the one material than with the others. Experience shows, also, that some architects carry their submission to ancient authority so far that they demand materials and methods of construction which were out of date soon after the cement era began in this country—some fifteen or twenty years ago. This is hardly as laudable a form of conservatism.

Demands are coming in by almost every mail for information about where to get plans for the construction of cement buildings. Almost every detail of a building is mentioned by some one, and nearly all are wanting something which will give them guidance in getting structures as nearly all concrete as possible.

What will the architects do to meet this demand? A few men have made successful designs for railroad stations, factories and houses, and many have made cement in a limited extent, but it may truly be said that no one has yet done anything toward satisfying the rapidly growing demand for studies of the application of cement and concrete to the common problems of dwellings, factories, etc., whether solid or in block form.

The demand can only be filled satisfactorily by a good architect, an artist as well as a constructor, who will become thoroughly familiar with the materials used and will develop proper methods of using them, or proper designs for buildings or building materials made of them. For such men there is a large, strictly professional business waiting. Articles in previous numbers of Municipal Engineering have indicated the mistakes of vendors of concrete block machines in respect to their neglect of architectural principles and of proper precautions that good product shall be turned out by those with which they place machines. This article is intended to point out to the competent architect what he can do in correcting these mistakes so far as the production of good buildings, both structurally and architecturally, is concerned. That he will at the same time step into a large professional practice will not be one of the least of the inducements. Thorough preparation for the work and devotion to the new material for its own sake are necessary to success. Imitation has failed in the past because it was not close enough to deceive, but imitation of the utmost perfection is still imitation and carries the elements of failure. The architecture must suit the material, though the forms which the material may take must be made to fit the details of the architectural design.

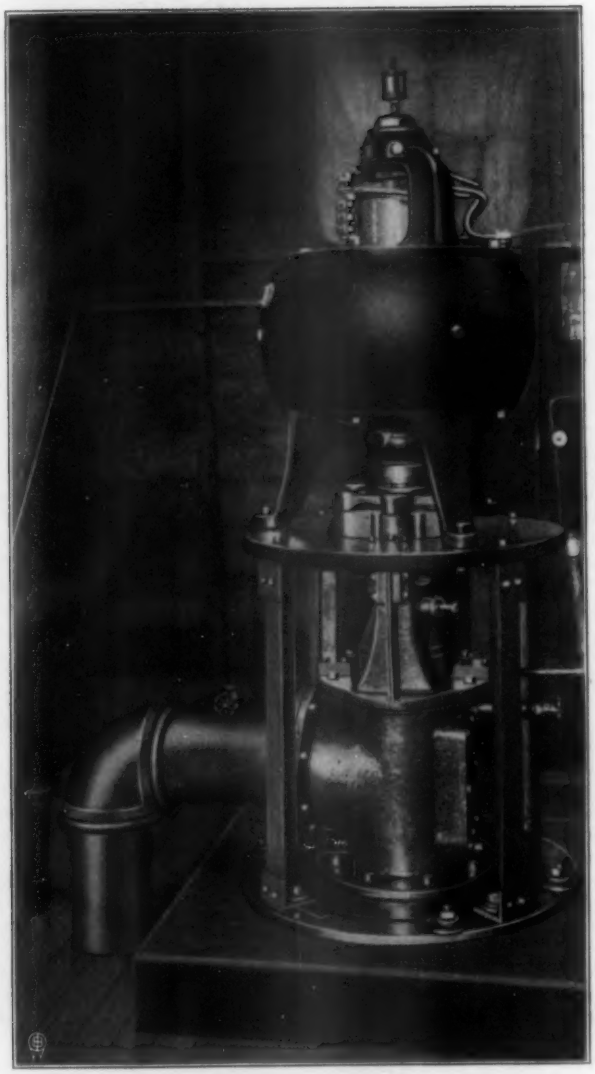
SEWAGE DISPOSAL AND THE SEPTIC TANK.

The Boston Society of Civil Engineers has been discussing the subject of sewage disposal, and the reports of the papers read and the discussions of the same are printed in the May number of the Journal of the Association of Engineering Societies.

Mr. Goodnough presented a paper on the sewage disposal systems in Massachusetts, which contains short statements of the conditions and results in the various plants, including the various filtration methods in use at Framingham, Gardner, West Gardner, Marlborough, Clinton, Brockton, Andover, Spencer, Southbridge, Concord, Westborough, Natick, Leicester and a list of private institutions using similar methods.

Mr. F. Herbert Snow read a paper on the adaptability of what is called the Massachusetts method of intermittent sand filtration to sewage disposal problems in other States. He briefly describes the plants at Saratoga Springs, N. Y., Lakewood, O., Marion, Iowa, Mt. Vernon, White Plains and other nearby municipalities in New York.

The discussion of these two papers brought out brief descriptions of chemical precipitation followed by filtration at Worcester, Mass.; intermittent sand fil-



PROPELLER PUMP AND MOTOR OVER WELL.
MADISON, WIS., WATER WORKS.

tration at Pawtucket, R. I.; chemical precipitation at Providence, R. I.

At another meeting Mr. Frank A. Barbour discussed the use of the septic tank in connection with sewage disposal works, including reference to tanks at Marion, Ia.; the Soldiers' Home at Sandusky, O.; Mansfield, O., and Saratoga, N. Y. Mr. Bolling detailed the experiments with septic tanks at Brockton, Mass.; Mr. Gavett described the tanks in use at Plainfield, N. J.; Mr. Pratt those at East Cleveland, Kenton, Mansfield, Sandusky Soldiers' Home, Trumbull County Infirmary, Ohio, and mentioned some smaller and more recent installations. Mr. Goodnough described the rather unsatisfactory experiments of the State Board of Health at Andover, Mr. Clark those at Lawrence, Mr. Kinnicutt those at Worcester and Mr. Winslow those at the Massachusetts Institute of Technology, all in Massachusetts. Mr. Snow, in summing up the disucssion, said that "opinions, rather than practically-demonstrated conclusions, must obtain at this stage of the development," and at the end of his closing speech expressed his opinion that " the staling of sewage in settling tank, disposal of solids while in a comparatively fresh state and in small quantities, and the oxidization of the supernatant liquid by one of several approved methods, is the safest and very best system for general adoption."

Whfle the descriptions of plants are not so complete as the close student of the subject would desire, the collection of them in a single pamphlet is a great convenience. Many of the plants mentioned have been described in Municipal Engineering magazine in greater detail and a number not mentioned have received full description and illustration in this magazine, the last two or three volumes, in particular, containing full data regarding some important installations not represented at the Boston Society meetings.

The adaptability of Massachusetts conditions to intermittent filtration and the comparatively unsatisfactory results of the experiments on septic tanks have prevented their use in that State, and the difference in conditions in other States, as shown by Messrs. Snow and Barbour have required the combination of the septic tank with filtration to secure the desired results. If to the short descriptions in the papers referred to are added the fuller accounts in Municipal Engineering of plants at Bedford and Richthe fuller accounts of municipal engineering of plants at Bedford and Richmond, Ind., West Allis and Milwaukee, Wis.; Glencoe, Ill.; Santa Monica, Cal., to mention only the most recent articles, a clearer idea of the state of advancement of the art of sewage purification will be obtained.

Some extracts from the papers will be found elsewhere in this number, giving data which have not already appeared in this magazine.

Mr. Snow is right in saying that individual opinions govern at the present time, but this is largely because the differences in conditions in various localities do not receive sufficient study and each engineer is too apt to assume that the success which he has attained after long experimentation at one locality can be obtained by applying his finally adopted methods with little or no modification at another locality. More devotion to principles and greater freedom in choice of methods of application are the lines on which the most rapid advance can be made.

THE WATER METER QUESTION.

Some new light is thrown on the meter question by Mr. Kops in his discussion of Mr. Knowles's tables and diagrams, which will be found elsewhere in this number. It would be interesting to know whether a collection of data from all the cities and towns which are introducing meters would show the same decided division into two classes which is evident in Mr. Knowles's diagram. It is quite possible that the classification is merely fortuitous, but even if the division line between the two classes of cities were assumed at 100 gallons consumption per capita per diem, the probability is that a similar result would be found for nearly every city or town to that shown in Mr. Kops's diagram for the class to which it belongs. Thus the city of Madison, Wis., belonging to the class below 100 gallons consumption shows an increase in consumption although the number of meters has rapidly increased, as is stated in the article on the Madison waterworks on another page.

At first sight this diagram made by Mr. Kops might be assumed as an argumen against meters in small cities, for in general, it is the small cities which are found in the class with small water consumption per capita, but a little study or a little knowledge of the facts in a few towns, will show that the two have no particular connection. Mr. Kops states the case in general in his article and the facts for Madison as given in the last

annual report of the Water Commissioners, corroborate his statement. The small town has ordinarily but little use for water beyond the ordinary household uses. If meters are on the taps the consumption per capita of population served probably lies between 15 and 40 gallons. If meters are not on the taps, the consumption is probably 40 gallons or more. Such an unmetered consumption is shortly reduced by putting on meters to one between the limits named. In the small towns the proportion of families served is in general smaller than in the larger town, wells being more generally in use and being more satisfactory from the sanitarian's standpoint than in the larger towns. If the consumption per capita is based on the entire population of the city, the figure will increase without there being any actual increase in the consumption per capita of persons using the water. If meters are introduced gradually this fact may be obscured, the increase in proportion of population served being offset in whole or in part by the decrease in consumption through the newly metered services.

It is true, however, as Mr. Kops states, that after the first shock of attachment of meters the consumption will increase on account of the willingness to use water more freely under the usual condition of reduction in water bills when fixtures are in good condition.

The argument for meters in the small town, or elsewhere, generally has the item of reduction in total water rate to the consumer who keeps his fixtures in good condition, and the citizen who is a little more careful than the average should therefore be a strong advocate of the meter system on the basis of its effect upon his own pocketbook. The difference shows in the bills of the man with leaky fixtures and who is careless in handling them and in using water. No one can complain if he is made to pay for his carelessness, and when he learns his lesson the coal bills at the pumping station fall off and the need for a new supply is postponed.

The public uses of water increase enormously during a certain stage of the city's growth. When the sewer system is put in water must be used to keep it clean. Drinking fountains come at one time or another. Street sprinkling is not practiced to any great extent until the city streets are filled up enough with houses or stores to make the travel heavy and the dust on unpaved streets thick, or until the streets are paved and dust dries up quickly and blows about. Lawn sprinkling is likely to become common about the time that streets are paved, or curbs, gutters and sidewalks are put in. All together, these public or semi-public uses of water produce a large increase in consumption of water which (except lawn sprinkling) does not affect the metered water record in the least. It does affect the per capita consumption of water, however, very materially, and if the study of the consumption of water is confined to the figures per capita of population for total consumption it will be very misleading. Thus in Madison it is very nearly true that the consumption of metered water per capita has been reduced fully one-third since meters were introduced, but the public uses of water increase the per capita consumption to three times that for private uses.

The separation of the metered water accounts from the public water accounts thus shows most clearly the injustice of taxing the average users of water for twice as much more water which they do not use, and makes an unanswerable argument for the placing of the burden of supplying this water upon the public which is benefited by these public uses.

Every tax-payer pays his share of the cost of this public water through his general city taxes and thus each citizen pays his equitable share of the cost of supplying water to the city and to its individual inhabitants.

The city of Worcester, Mass., whose water works are described in another article in this number of Municipal Engineering, seems to come under the same class as Madison, the consumption per capita when meters were introduced having been estimated at 83 gallons per diem. The meters materially reduced the consumption for private purposes, but for the last four years there has been a tendency to increase above the average consumption of 70 gallons derived from the averages in Mr. Kops's diagram. The article referred to attributes this increase to insufficient check upon unauthorized use of water through unmetered connections supposed to be used for fire purposes only. The water works associations have discussed this question at length and thus far have found no sure method of preventing the stealage of water except that of putting meters on such fire protection connections.

There is an occasional city in which the arguments of Mayor Bruen of East Orange, N. J., quoted on another page, find proof, but in the great majority of the cases which have been reported, the saving in cost of house to house inspection, in cost of pumping and in saving of fixed charges on extensions of water supplies have greatly exceeded the increase in cost of installing meters and reading them.

THE QUESTION DEPARTMENT

SPECIFIC HEAT OF ASPHALT.

What is the specific heat of asphalt?
W. P. C., New York City.

No record of the determination of the specific heat of asphalt having been found, information regarding the matter was sought from Mr. A. W. Dow, chemical engineer, Washington, D. C. He has very kindly made the determinations and presents the following as his results:

—Specific Heat of Asphalts.—

Refined Trinidad asphalt	0.350
Cuban asphalt cement	0.401
Trinidad asphalt cement	0.381
Bermudez asphalt cement	0.413
Maracaibo asphalt cement	0.447
Quartz sand	0.201

These results were all verified in triplicate with apparatus giving correct results on substances of known specific heat. Knowing the per cent of asphalt cement and sand in a paving mixture the specific heat of an asphalt pavement can be computed from these data.

OIL ON ROADS.

I notice in your magazine that the oiling of streets is gaining in fame. Do you know of any engineering work that treats on the subject? Our town has put down a lot of macadam and it is very dusty. I am urging investigation of the oil proposition. I believe a preparation of coal tar would be better. A. H. KENNEDY.
Rockport, Ind.

The oiling of roads is still in the experimental stage and the subject has not yet been treated in the text books. The oils used in California, where the oiling of roads has been most successful, have an asphaltic base, so that the heavier oils from distillation processes, which are used for road purposes, approach more nearly to the quality of tar than they do to that of the oils of the East, which have a paraffine base. Possibly the difference in base of the oils used is the reason for success in California and failure in this part of the country. Coal tar is used in Europe with some success in a manner similar to the use of oil in California. The most scientific development of the use of coal tar in macadam pavement is the bitulithic pavement, which has frequently been described in this magazine, and has been uniformly successful.

The subject of oiling roads has been treated in a number of articles in Municipal Engineering, among which are the following: Vol. xvi, pp. 50 and 105; vol. xvii, pp. 37 and 100; vol. xviii, p. 171; vol. xix, pp. 20 and 22; vol. xx, pp. 16, 214 and 234; vol. xxi, p. 173; vol. xxiii, pp. 41, 463 and 464; vol. xxiv, p. 57; vol. xxv, p. 45; vol. xxvi, pp. 53 and 428. Nearly all of these are reports of experiments. The article in vol. xxiv, p. 57, is a further rather unfavorable report of the experiment in England, described in vol. xxiii, p. 464. That in vol. xxvi, p. 53, gives the specifications for oiling streets which are in use in Bakersfield, Cal.

Other articles will be found in this and in future numbers of Municipal Engineering. Engineers who have visited California report their observation of very successful results, the use of the oil with asphaltic base on very dusty sand roads, to relieve the dust nuisance on the fruit farms, having given a comparatively hard, elastic, asphalt-like surface, free from dust and capable of taking a goodly amount of travel.

MARGIN FOR END OF BRICK PAVEMENT.

I have been using 2-inch white oak planks for headers on brick block improvement. Objection is made on the score of durability. Is it good or bad practice to use them instead of stone?
C. M. B., ————, O.

Planks are so often used that it can hardly be called bad practice to use them. In fact, it may often be the best practice possible. If the pavement is likely to be extended within a reasonable time, i. e., the length of life of the plank, it is certainly permissible to use them if they are cheaper than stone. Creosoting the planks will lengthen their life and by so much remove the objection to them from lack of durability. Good, hard, tough stone is certainly preferable from the standpoint of durability, but may not be the most economical, if proper repairs are made as they are needed. If, as is too often the case in small cities, repairs are neglected, the greater first cost of the stone margin is money well expended.

INFORMATION ABOUT CREOSOTED BLOCK PAVEMENTS.

Can you advise us of any publication covering the question of creosoted block pavement? I should also like an index to any articles you have published covering the same. GEO. W. BESTOR,
Minneapolis, Minn.

Tillson's "Street Pavements and Paving Materials," ($4) has a chapter on wood pavements which contains an epitome of the knowledge of the subject at the time the book was issued, about four years ago. Specifications for creosoting blocks and for laying pavements with them are given. Judson's "City Roads and Pavements," ($2) has a page or two on the subject; so does Spalding's "Text Book on Roads and Pavements." Byrne's "Highway Construction," ($5) has a chapter on wood pavements, but pays little attention to creosoting. There is a short chapter in Baker's "Roads and Pavements," ($5) which is quite up to date, the book having been issued last year.

The fullest information regarding creosoted wood block pavements is to be found in the volumes of Municipal Engineering.

The method of creosoting blocks and laying pavement in Galveston, Tex., in 1895 is described in vol. viii, p. 206. The beginning of work in Indianapolis, in which city the present methods of work have been developed, is reported in vol. x, p. 407. The advantages and disadvantages of this class of pavement were discussed in vol. xi, p. 172. There is quite a spirited discussion in vol. xv, pp. 137, 141, 233, 304 of the advantages and disadvantages of the pavement in the stage of development attained in 1898. Mr. M. A. Downing of Indianapolis gives a history of the pavement in Indianapolis in vol. xvii, p. 288. There have been several articles on the use of creosoted wooden blocks for paving in the last two or three volumes of Municipal Engineering, vol. xxiii, p. 380; vol. xxiv, pp. 55, 107, 136, 137, 232, 314, and vol. xxv, pp. 30, 128 and 312 touching upon nearly all phases of the subject. Two of the most valuable articles will be found in vol. xxv, p. 328, on "Wood Paving Specifications in Greater New York," and p. 333 on "The Development of the Kreodone Block Pavement." These are carefully written articles giving the stages of advancement which the principal forms of treated wood block pavement have attained.

The annual volumes of proceedings of the American Society of Municipal Improvement contain more or less discussion of the subject of wooden block pavements, beginning with that for 1896. They can be obtained for one dollar each.

ISOLATION HOSPITALS.

Could you inform me where I could find out about isolation hospitals and their general construction—hospitals for contagious diseases?

WILLIAM H. GRADY.
Bangor, Me.

Chapin's "Municipal Sanitation in the United States" ($5) has a chapter which gives a supply of information such as is asked for. It is illustrated by photographs and plans and shows hospitals of all sizes and costs, some of which are well planned and some of which are a disgrace to the communities constructing them. Worcester's "Small Hospitals, Establishment and Maintenance" ($1.25) may be of use. It contains plans for a small hospital.

BOOKS ON SEWAGE PURIFICATION BY SEPTIC TANKS.

Are there any books published on the modern septic tank method of sewage disposal. F. M. BOYD, Newberry, S. C.

This method of sewage disposal is still in the experimental stage and in this country has not been in operation long enough to warrant books on the design of plants to operate under our conditions. The question of sewage disposal is an older one and has been of prime importance longer in England than in this country, so that there are several books upon the subject by English engineers, which have chapters upon the septic tank as one of the methods of sewage purification in use. The composition of sewage is quite different in the two countries and climate and other conditions are not the same, so that the details of English plants are not directly applicable to American installations. The principles of application are practically the same, however, so that the reports of the results of English experiment are of value to the American engineer in laying out his experimental work and approximating to a design suitable for the conditions he meets.

Some of the English books are described in Municipal Engineering, Vol. xxiv, p. 363, vol. xxiii, p. 294, etc. In vol. xxiv, p. 363 is also a list of articles in Municipal Engineering describing plants for sewage disposal in operation in America, most of which have septic tanks as all or part of the apparatus in use.

WHAT IS THE INVERT OF A SEWER?

The cross section of a sewer is horseshoe shape with a bottom of larger radius. The specifications require that the invert of all storm sewers larger than 40 inches inside diameter shall be lined with one course of No. 1 paving brick, set on edge in Portland cement mortar; also that all brick sewers will have two rings unless special section is designated, and that the invert and sides for 1½ feet high must be surface filled with cement mortar and must be well rubbed until no projections exceeding ⅛ inch are left. The bottom of the cross section of the horseshoe shaped sewer, of large radius, is designated as paving brick in the printed cross section drawing of the sewer.

Would the paving brick stop at the break (junction of bottom and side) as shown on the plan, or would it go to the springing line of the arch?

M. F., Cedar Rapids, Ia.

The answer to this question seems to depend somewhat upon the definition of the term invert, though the marking of the words "paving brick" in the bottom of the cross section and not in the sides give rise to a presumption that only the bottom of the sewer is to be lined with paving brick.

Trautwine's definition of an invert is "an inverted arch frequently built under openings, etc." In a circular sewer the invert would be the entire lower half of the cross section. In an egg-shaped sewer it is quite common to designate the part of the cross section below the springing of the arch in general terms as the invert, but in considering the detailed construction of an egg-shaped sewer such authorities as Latham, Ogden, Moore, etc., call the bottom of the sewer, with the smallest radius, the invert; the arcs joining this portion with the arch, the sides, and the portion above the springing line, the arch. Latham is also very definite in his descriptions of the parts of sewers built in other forms than those mentioned, and nearly all of them are composed of invert or bottom, sides, and arch. Included in these forms is the horseshoe shaped section. The weight of evidence seems therefore to be in favor of calling the bottom arc of the horseshoe shaped sewer the invert, the curve above the springing line, the arch, and the curves joining the invert, and the arch the sides. The section of the specifications quoted apparently contemplates an egg-shaped sewer, as well as a horseshoe shaped sewer, when it speaks of surface filling the invert and sides with cement mortar, which would indicate that the detailed definition of invert given above was in mind rather than the "general terms" referred to.

There may be some special circumstances in a particular case which would modify this conclusion for once, but in general it may be stated that the invert in a horseshoe shaped sewer is the bottom only and that the specification requiring the lining of the invert with paving brick would not apply to the sides of the sewer between the junctions with the bottom and the springing line of the arch.

A DRAINAGE PROBLEM.

In running levels for tile drains in a river bottom I find the following conditions: Along a creek tributary to the river and parallel to it is a natural levee of gumbo and alluvium, through which there is a gap, which is the natural outlet for surface water. Occasionally, as in June, 1903, the river gets high enough to pass the gap and flood the lands inside. The bottom is gumbo underlaid with sand. It is proposed to erect a dam and close the gap so as to keep the river water out. The water collected above the dam from rains will, I am afraid, be too much for our four-inch pipe, three or four feet underground. I thought of laying an extra four-inch pipe or culvert at or near the surface of the ground to take off the surface water quickly. How would it work? J. A. W., ——, Mo.

The overflows from the river are very infrequent, apparently, and rain storms are relatively very frequent. The surface soil seems to be far from porous. A small drain through the levee at the ground surface would become stopped very easily, or if open would let in the flood water as well as let out the rain water. The latter is true of the tile drain. Also the tile drain would act slowly in removing the rain water. By constructing the dam would you not be exchanging an occasional overflow of river water for frequent total or partial floodings by surface water?

DIRECTORY OF MUNICIPAL OFFICERS.

Will you kindly refer us to a directory of municipal officers in the United States?

W. C. P., Pittsburg, Pa.

There is no such directory published. Occasional prospectuses of such publications are received, but they do not seem to meet with sufficient encouragement to warrant completion of the book. The Municipal Year Book ($3), issued about three years since, contained a partial list of municipal officials, with other information. The list was out of date almost be-

fore the issuing of the book. The last edition of the Directory of American Cement Industries ($5) contains the latest list of city engineers of municipalities of more than 2,000 inhabitants, the city engineers being noted in the list of "Engineers, architects and others supervising the use of cement." There is occasionally a newspaper, the Indianapolis Sentinel, for example, which issues an annual "Almanac," in which will be found a fairly good list of city officials in the State in which the paper is published.

DIRECTORIES OF TRADES AND PROFESSIONS.

Will you please advise us wether there is published an authentic list of architects and if so where it can be obtained?

We would also like to secure a similiar list of wholesale jobbers of stoves, not manufacturers.

Is there a published list of hospitals in the United States?

K. & J., Columbus, O.

The latest and best list of architects covering the whole of the United States and Canada is the "Architects' Directory" for 1903-4 ($2). It is classified by States and towns and gives street addresses and professional society affiliations. There are also lists of architects and builders in Ohio, Columbus, western New York, Pittsburg and Chicago.

The Thomas Publishing Company, 220 Broadway, New York, publishes trade lists of machinery and metal trades and wholesale and retail hardware dealers. The Hardware Dealers Magazine, 253 Broadway, New York, publishes a list of hardware jobbers.

Possibly Burdett's Hospital and Charities Annual ($2), published by Charles Scribner's Sons contains the list of hospitals desired.

DIRECTORY OF STONE INDUSTRY.

Is there a directory similar to the "Directory of American Cement Industries" regarding the stone crushing industry, contractors and purchasers of stone, etc?

E. J. L. & CO., Philadelphia, Pa.

No such directory is known to the writer. If any reader of this magazine knows of such a publication he will confer a favor by sending the name of the publisher to this office.

The list of contractors and other users of cement in the "Directory of American Cement Industries" ($5) might be used as a list of purchasers of stone, especially crushed stone, as most of them use such material in making concrete.

PUBLICATIONS DEVOTED TO THE CLAY INDUSTRY.

Will you kindly give me the name of any publication, either book or magazine devoted to the clay industry, especially paving brick and sewer pipe.

G. H. H., Red Wing, Minn.

Periodicals devoted strictly to the clay industry are "Brick" of Chicago; "Clay Records" of Chicago; "the Clay Worker" of Indianapolis. Others devoting a portion of their space to this industry are "Municipal Engineering" ($2) of Indianapolis, Ind., especially the qualities and use of paving brick and sewer pipe, "Rock Products," Louisville, Ky. "Municipal Engineering" gives as full treatment of paving brick as can be found anywhere.

Among the books on the clay products mentioned in the question the following are known to be good:

Chase's 'Brick Pavement." ($1.)

Burke's "Brick for Street Pavements," (50 cents.)

Wheeler's "Vitrified Paving Brick,' ($1.)

There are also excellent chapters on brick pavements in the books on pavements and paving materials mentioned in the answer to the question concerning creosoted block pavements elsewhere in this department. Baker's "Roads and Pavements," ($5) is particularly full and valuable on the subject of brick and brick paving.

MANUFACTURERS OF HIGH CALCIUM LIME.

Will you please advise us if you have in your files any information as to the names and locations of manufacturers of high calcium line, i. e., lime which will analyze over 90 per cent calcium oxide?

M. H. L., Chicago, Ill.

The reports on "Mineral Resources of the United States," issued annually by the United States Geological Survey, contain statistics of the limestone industries, and volumes issued prior to 1900 contain frequently analyses of limestone and of lime from various localities. From such of these volumes as are at hand, the following list of localities in which lime with more than 90 per cent calcium oxide is manufactured is compiled:

Alabama—Sheffield and Russellville, Franklin County; Siluria, Shelby and Longview, Shelby County; Anniston, Etowah County.

Arkansas—Johnson.

Indiana—Bedford and Clear Creek, Lawrence County; Kokomo, Howard County; Romona, Owen County; Kenneth, Cass County.

Maine—Union.

Maryland—Cavetown.

Massachusetts—New Lenox, Cheshire, Renfrew, Berkshire County.

Missouri—Hannibal, Marion County; Ralls County; Ashgrove and Springfield, Green County; Glencoe, St. Louis County.

New York—Hudson, Montgomery County; Erie County; Schoharie County; Chazy, Clinton County; Ulster County; Glens Falls; Mechanicville, Washington County; Smith's Basin; Jamesville, Onondaga County.

Ohio—Columbus, Franklin County; Rex, Miami County; Youngstown, Lawrence County.

Pennsylvania—Somerset County; Chester County; Reedsville, Mifflin County; Northumberland County; Butler County; Richland Station, Lebanon County; Franklin County; Hanover, Adams County; Emigsville, York County.

Texas—Oglesby.

Vermont—High Gate Springs, West Rutland, New Haven, Addison County; Proctor, Swanton, North Pownal, Leicester Junction, St. Albans.

Virginia—Botetourt County, Riverton, Warren County, Eagle Rock.

West Virginia—Fort Spring and Snowflake, Greenbrier County.

Michigan—Bellevue, Dundee, Monroe County, Sibley, Wayne County, Alpena.

Perhaps our readers will add to this list from their personal knowledge.

CONCRETE BLOCK ARCHITECTURE.

The following extracts from a letter written by a practical manufacturer of concrete block and concrete block machines will be of interest in connection with the articles on concrete block architecture and concrete block manufacture, which have recently appeared in Municipal Engineering.

Your editorial in May, 1904, page 311 on "Concrete Block Architecture" is the most enlightening piece of news we have read for a long time. No machine can make product too exact, and the coming problem is not so much "cheaper than brick" as "cheaper than stone and marble." It would not be proper for me to verify by detailed facts within my own knowledge where (some) machines fell down because the architects made half a dozen plans and then gave up plans and worked out the problem on the scaffold. (Another) machine was used by this same architect, who has recently erected a building exactly as planned and not a dollar (was spent) cutting blocks to fit the wall. This architect can now make plans. No machine of any kind is useless, and all machines are worthy of trial, because the art is passing through an educational era. Experiments with cheap machines are useful, but a machine that can manufacture product for a dozen large buildings and thereafter require less than $25 on repairs is not to be sneered at by practical business nem.

WALLS AND BLOCKS OF CINDER CONCRETE.

Please give me a formula for making concrete walls and foundation blocks of cement, sand and engine cinders. Will blocks made of engine cinders stand frost if laid on top of the ground?

G. W., Galesburg, Ill.

Cinder concrete is not recommended for walls and foundation blocks. Its strength under compression is not half that of concrete made with gravel or broken stone, if made with rich mortar, and in the poorer mixtures, such as 1 cement, 3 sand and 6 cinder, is but little more than one-fourth as strong. This brings the strength of concrete walls below that of brick masonry and would require thicker walls and good distribution of stress. The concrete is more porous, ordinarily, when cinder is used than when broken stone or gravel is used in the same proportion, so that water would be absorbed more readily and in greater quantity and the action of frost would be more pronounced.

THE BEST CEMENT BLOCK CONSTRUCTION.

Please advise me of the names of one or two of the best cement block machine makers. I would also appreciate any further points regarding the making of blocks that may be in your possession.

F. M. L., New London, Conn.

A block machine should be chosen with special reference to the work to be done and to the local conditions. Practically all of the prominent makers of cement block machines advertise in Municipal Enginetring and their advertisements and circulars will give much of the information desired. See the "Business Directory" published in eacn number of Municipal Engineering under the headings "Cement Construction," "Cement Machinery," "Concrete Blocks," "Cement Work," for names of makers of machines.

Municipal Engineering Magazine contains much which should be oi value in selecting a machine. Attention is called in particular to the article on "Concrete

Block Architecture, vol xxvi, p. 313, and to one on "Concrete Block Manufacture," vol xxvi, p. 389. Nearly every number for the past two or three years has something of value on the subject. This number has some valuable special information.

HOW TO BUILD CONCRETE WALLS.

The whole business section of Fernie was burned recently. Many business men are contemplating building cement walls. What I want to know is the thickness of walls that ought to be used in one, two and three-story buildings; also the proportions of cement and stone that ought to be used and the best and cheapest way to do the work. Is there a book that contains what I want?

R. A. K., Fernie, B. C.

The "Handbook for Cement Users" ($3) is the most practical book which has been published upon this subject. It contains specifications for cement, cement mortar and concrete of various constitution and descriptions of methods of putting them in place.. Concrete can also be made into blocks, hollow or solid, for use in walls. These are briefly described in the book. In the two years since the book was issued there has been a large development in the manufacture of cement blocks and many new machines for making them have been invented. The latest upon the uses of cement will be found in the current numbers of Municipal Engineering Magazine and in every number since the issue of the Handbook will be found much of direct value to the contractor and the builder using cement and concrete.

BOOKS ON CEMENT WORK.

I want to get all the information I can on granitoid work, such as sidewalks, also foundations and building blocks of concrete and cement. Can you refer me to formulas for the different classes of work? J. T. C., Hannibal, Mo.

Wishing to get a book on concrete and seeing the "Handbook for Cement Users" advertised, I write you to know if it describes the use of cement in all its details, such as sidewalks, concrete foundations, etc. Is there any better book published? A. R., Corning, N. Y.

The "Handbook for Cement Users ($3) was prepared expressly to fill the demand for a book on the practical use of cement and concrete. It does not occupy any part of the field of any other book on cement or concrete which has been published in this country. It gives the best specifications for cement for all purposes and samples of the best specifications for the use of cement, including instruction in the details of the operations, data for estimates, etc. The demand for it is evidence that it meets the need for such a book.

The current numbers of Municipal Engineering Magazine ($2 a year) contain the latest upon these subjects. A subscription to the Magazine begun at any time in the last three years will be worth its cost for the instruction in cement working alone, although this is but one department in a magazine devoted to all parts of the field of municipal improvement. Special attention is called to the articles on concrete block architecture and construction in the May and June numbers for those who are contemplating the manufacture of concrete blocks and artificial stone, and to others in this number.

BOOKS ON STEEL-CONCRETE CONSTRUCTION.

Please inform me if there is any practical book on steel-concrete published in English. GEORGE STORY,
City Engineer, San Luis Obispo, Cal.

The only American book on the subject of steel-concrete with which the writer is acquainted is Mensch's "Reinforced Concrete Constructions" ($2). This book is entirely descriptive in its nature and has many illustrations showing many of the uses to which steel-concrete has been put.

Considere's "Experimental Researches on Reinforced Concrete" ($2) has been translated from the French and is now obtainable in English form. It goes into the details of tests upon the ability of reinforced concrete to withstand the various stresses to which it is subject and is a very valuable study of this comparatively new building material.

Hagloch's "Treatise on the Manufacture of Artificial Stone and Concrete" ($1.50) has a short chapter on reinforcement.

CONCRETE ARCHES—PATENTS ON CONCRETE STEEL CONSTRUCTION.

What information can you give me or to what authority can you refer me in regard to the construction of concrete arches for bridges? What is your opinion of the value of wire netting for reinforcement?

Please advise if the construction combined with steel is patented and if so on what particular devices.

E. E. LYST, Anderson, Ind.

Reference may be made to the answer elsewhere in this department to question regarding information about concrete-steel construction for names of

books treating that subject. With reference to concrete arches without steel reinforcement there are no particular text-books. Concrete has a crushing strength similar to that of the stone of which it is composed and, if its power to resist a small amount of tensile strain is neglected, it can be treated in designing in the same manner as stone. Some engineers, to prevent the cracking which takes place in large masses of exposed concrete, on account usually of temperature strains, divide the arch ring into divisions similiar in form to what they would be if of cut stone. A description of the concrete bridge of the Illinois Central Railroad over the Big Muddy River, in Municipal Engineering, vol. xxvi, p. 152. shows a good design for this method of construction.

Wire netting is used successfully as reinforcement of concrete in small structures not subject to great strains, and permits lighter weight, and more elaborate designs in ornamental features. The first application of steel in the reinforcement of concrete was in a similiar form for the construction of flower pots and vases, and the method has since been attached to ornamental structures attached to other structures and also to some essential structural details such as light walls, floor slabs, partitions and the like.

Methods of computing the strains in the concrete and in its reinforcement have been devised, and they demand a certain proportion of area of reinforcing steel, which must also be proportioned to the strains to be carried. The requirements of strength and of the various theoretical studies have given rise to many different forms of steel reinforcement, which are really developments from the original network of wire or rods, so that wire netting is now but one of many acceptable forms for concrete reinforcement, from which choice must be made according to strains to be expected, conditions of construction, royalties, etc.

Steel reinforcement of concrete is so old that the early patents have expired. Some of the early methods never were patented in this country. There are, therefore, forms of steel reinforcement which can be used without infringing any existing patent. An article in Municipal Engineering, vol. xxiv, p. 127, describes and illustrates the more prominent systems of steel reinforcement used in the construction of arches, all of which have been patented, and all but one of which are probably fully protected by still existing American patents. New patents are issued on special methods of construction or on special forms of reinforcing material at frequent intervals so that one must keep watch of the patent office records to keep informed on the forms which cannot be used without payment of royalties.

CONCRETE—STEEL FOR BUILDING CONSTRUCTION.

Inclosed I send you a clipping from one of the Milwaukee papers. I wish you would tell us through Municipal Engineering if there is any truth in the statements set forth in the article in regard to concrete being an unsafe building material. G. W. C., Wausau, Wis.

Inclosed find clipping from a paper of this city having an article by J. J. Mahoney. He makes statements which we feel cannot be borne out with facts and cites a number of instances where concrete construction has proven unsafe. Can you give us any information regarding the buildings referred to that would disprove his statements? H. G. G.,
Akron, O.

Both the articles referred to in the above communications are from officers of bricklayers' and masons unions and by the very exaggeration of statement with which they are filled throw doubt upon the accuracy of the statements made. Conservatism in accepting new methods of construction is very proper, but the results desired cannot be reached through misstatements, whose bias is so apparent that it destroys the credibility of the article containing them. It is true that accidents have happened to badly designed concrete and concrete-steel structures and parts of structures. It is equally true that similar accidents have happened to similar bad structures in brick, stone and steel. The three latter materials are much older than the two former and the experimental stage has passed, but this does not prevent accidents due to carelessness or ignorance of designers or builders. These accidents do not prove the lack of suitability of brick, stone, steel, or concrete for building purposes. They only show the necessity for knowledge of the materials and of the principles of stresses in structures and methods of carrying them safely.

The list of buildings named in the article from Akron is a part of the list in the Milwaukee newspaper and both are from yet another list made up by a publication which makes a business of collecting all the accounts of failures of any building material, except one class of one kind in which its publishers are particularly interested. The facts about some of the buildings mentioned can be gathered from the publication referred to, and

when divested of the bias of the reporter are about as follows:

Lawrence Savings and Trust Bank Building, New Castle, Pa. In this case the centering under newly constructed concrete floors was removed too soon and the floor collapsed. The fact that so many of the steel rods were completely stripped of concrete is evidence that the cement had not yet fully set. This accident may be classed with the collapse of the steel skeleton of the Darlington building in New York during construction because the floor beams and columns were overloaded before they were sufficiently fastened together, and failure of a single column brought down the whole building. Concrete steel was not the cause of the destruction in the one, nor was steel the cause in the other. In both it was primarily the haste and the carelessness of contractors.

Clark County court house at Marshall, Ill. Part of a concrete floor fell when the centering was taken out. There seems to have been much complaint of the insufficiency of the plans and of the poor work done by the contractor before the accident, and the cause to which the failure is attributed by the periodical referred to is cheap concrete. The architect has been deposed and better materials and better work are to be required. This trouble seems to have arisen from inexpert designers and too great desire for cheapness, and the resulting concrete floor would not stand with a span of twenty feet. The results of defective design and hammering down of cost under incompetent advisers can hardly be attributed to the materials used.

Hotel Otsego, Jackson, Mich. Three floors fell, the first to give way supporting the false work of the floor above. The defective design is shown in the description. Wire cables, attached to the walls, with rods and wire fencing and cinder concrete formed the floors, and the failure came from the weight on the floor pulling in the walls. This shows very defective design. It is learned from independent sources that the construction under way was proceeded with under the protest of competent engineers who pointed out its entire insufficiency. Saving in cost of engineering advice and in plans, and the gross ignorance of the contractor concerning concrete materials and methods of construction are the evident causes of this failure. Many thousand such failures have taken place with all kinds of materials and still take place where there is not sufficiently close inspection of plans by competent municipal authority.

Paddington apartment building, Chicago, Ill. This is another case of cinder concrete, kept wet by rains, and supports removed before the cement had fully set. The removal of supports was probably aggravated by the weight of water absorbed by the floor, which is reported to have been made of one part cement to six parts of cinders, concrete of such materials and in such proportions being both porous and low in strength. Fuller accounts of the accident state that the supports were removed by a workman contrary to orders. Gross carelessness and lack of discipline are the most evident defects in this instance, but too close approximation to ultimate strength of materials in the effort to reduce cost is but little behind.

Norman-st. public school building, Boston, Mass. Good materials seem to have been used in this instance, but the stone used was of too large size and the mixture of concrete was not well made, the result being concrete of unequal strength. A section of the fourth floor, 11 by 25 feet in area, fell and went through to the basement. It it said also that some of the concrete had been frozen, and it was porous enough to give frost its full opportunity to disintegrate the structure. Improper mixing can only result from carelessness or desire to save in cost of making the concrete, based on ignorance of what every user of concrete should know.

Concrete roof in department store under construction in Corning, N. Y., fell and carried with it floors and wall. Notice had been served on contractor that defective materials were being used by the sub-contractor on concrete, the roof was laid in freezing weather and was being dried out by artificial heat, a combination of ignorance and carelessness or worse for which the system of construction could hardly be held accountable.

Floors of Carnegie library at Binghamton, N. Y. The arches were laid on Dec. 2 on the first floor, froze at night and were being filled over on the following day with dry cinders when four sections of the floor fell, evidently from overloading of centering, which was too weak for the load put upon it. This collapse was evidently not affected by the kind of material with which the centers were loaded.

Floors in court house at La Crosse, Wis. This was another case of weak centering, the flow giving way during the process of depositing the concrete. Stone arches

have fallen for the same reason, but th' does not condemn the use of stone for arches any more than it does the use of concrete for floors.

No details of the other failures mentioned in the newspaper clippings are given in the numbers of the periodical referred to which are at hand, but minute details of many of them are given in the current engineering periodicals, and they show similar reasons for failure, based on defective designs, insufficient specifications, carelessness, ignorance or dishonesty of contractors or undue haste. It is too often assumed that unskilled labor can be used in concrete work, when the fact is that it requires as much knowledge and expertness as brick and stone work. However, with sufficient expert supervision it is possible to use common labor for handling materials and mixing and placing concrete. This expert and honest supervision is, however, an absolute essential to good and safe construction.

THE MACHINERY OF A MODERN CEMENT PLANT.

We would request you to give us a general idea as to the kind and number of machines that enter into the construction of a modern cement plant. What appeals to us in particular is the work of grinding, sifting or grading and packing. The names of the makers of the principal machines that are now used would be of interest to us.

N. & M. Co.

The long list of machinery and apparatus for cement plants in the headings of that department of the "Directory of American Cement Industries," ($5) third edition, just issued, shows what machines are in use and gives the names of many manufacturers of and dealers in them, including all of the principal firms.

These machines may be roughly divided into the following classes:

Quarry machinery for rock plants.
Dredging machinery for marl plants.
Crushing machinery.
Mixing machinery.
Raw material and clinker grinding machinery.
Drying machinery.
Coal pulverizing machinery.
Calcining machinery.
Cooling machinery.
Storage and packing machinery.
Power development and transmission machinery.

Conveying machinery of many kinds including the carts taking rock from quarries, the pumps for transferring the slurry in wet process mills, conveyors for hot clinker, belt, bucket, chain and other conveyors and elevators for dry materials in various stages, air blasts for delivering powdered coal or cement, etc.

Some articles upon the various processes and upon the varieties of machinery for them are in prospect for future numbers of Municipal Engineering. At this time it may be sufficient to give the following classified list of machines and to refer to the "Directory of American Cement Industries" for the names of makers. Evidently, not all the machines named under any head are in use in any one plant, since the list includes machinery for natural and Portland cement plants, dry and wet processes, with slag, stone, marl, clay, and other materials.

Quarry Machinery—Cable tramway, car movers, derricks, rock drills, small locomotives, rails and portable track, steam shovels, tipples.

Dredging Machinery — Dredges and shovels, excavators.

Crushing Machinery—Stone, cement, and clay crushers, crushing rolls.

Mixing Machinery—Agitators, cement mixers, pug mills, separators, tanks.

Grinding Machinery—Ball mills, steel balls, bolting machinery, buhr mills, dust collectors, feeders, grit mills, cominuters, pebble mills, pebbles, pulverizers, roller mills, screening machinery, silex lining, slurry mills, slurry tanks, spouting, tube mills, under runner mills.

Drying Machinery—Rotary dryers, tunnel dryers, filter presses, heaters.

Coal Pulverizing Machinery—Coal handling machinery, coal crushers, rotary coal dryers, wash mills.

Calcining Machinery—Fans, feed pipes, rotary kilns, lining for kilns, mechanical draft.

Cooling Machinery — Clinker coolers, fans.

Storage and Packing Machinery—Bag handling machinery, bags, barrel machinery, bins, overhead track, packers.

Power Development and Transmission Machinery—Belting, boilers, chains, clutches, electric generators, electric motors, engines, gauges, gearing, grate bars, grease cups, gudgeons, hangers, lubricators, mechanical stokers, pulleys, rope drives, shafting, speed regulators, sprocket wheels, tighteners.

Conveying Machinery—Air hoists, boots for elevators, buckets for elevators, conveyors, etc., cars, conveyors, traveling cranes, elevating machinery, hoisting machinery, hoppers, pumps, trucks, wagons.

Machinery used for several of the above purposes—Air compressors, bearings,

blowers, conveyor, eccentric, flat, and other boxes, brushes, castings, dump wagons and cars, forgings, scales, scoops.

COLORING FOR CEMENT BLOCKS.

Will you kindly furnish me with the formula for coloring cement blocks for door steps and window heads and sills to imitate brown stone so largely used in Philadelphia and New York for cut stone trimmings. The blocks are to be made of 1 part cement and 2 or 3 parts bar sand.

O. W., Philadelphia, Pa.

The "Handbook for Cement Users" (83) recommends the use of roasted iron oxide for coloring cement brown in the proportion of 6 pounds of the oxide to 100 pounds of cement. This will probably not produce existly the color desired to imitate the brownstone mentioned, both because this particular stone was not in mind when the proportions were fixed and because different proportions of sand will modify the color of the mixture. Possibly some other color must be mixed in to produce the exact shade desired; for example, red iron oxide, producing a reddish tinge. The exact proportions must be obtained by experiment and for each proportion of sand used. The best color result would be obtained by using sand obtained by crushing the same brownstone which it is proposed to imitate. Clean refuse material from quarry or stoneyard would be satisfactory if reduced to proper size, unless its cost would be too much greater than bar sand.

MUNICIPAL MATTERS IN COURT

Higher Courts—Conflict of Lighting Companies—Water Meters—Garbage Contract—Evasion of City Debt Limit—Deduction for Use of Cheaper Cement.

Abstracts from Decisions of the Higher Courts on Matters of Interest to Municipalities.

Prepared by Russell T. Byers, LL. B., Indianapolis.

Assessment Limited by Benefits—Improvement Districts Legal in Dallas—The cost of a local improvement may be assessed against property only to the extent that it is benefited. The provision in the charter of Dallas authorizing the creation of improvement districts is constitutional. A homestead is liable for an improvement assessment under article 16, section 50 of the constitution. 80 S. W. Rep. (Texas), 874.

Damages and Benefits—Failure to Claim Damages—You may not attack an assessment collaterally on the ground that the damages exceed the benefit. Failure to claim the damages provided for is a waiver of such damages. The right to damages incident to street work does not arise under the statute, but the constitution. Under the street improvement act an objection to an assessment district must be taken in due time or it is deemed waived. Duncan vs. Ramish, 76 Pac. Rep., (Cal.), 661.

Lump Sum Estimate Not Sufficient—An estimate of the engineer, which gave the cost of an improvement in a lump sum, is not sufficient. City of Peoria vs. Ohl, 70 N. E. Rep. (Ill.), 632.

Engineer's Estimate Must Appear in Improvement Resolution—The estimate of the cost of an improvement when made part of the resolution by reference only, is not sufficient, when there was no record kept of such estimate. Under the statute a filing, indexing, etc., of such estimate by the engineer is not sufficient. The statute in question applies to the entire State. Chicago Union Traction Company vs. City of Chicago, 70 N. E. Rep. (Ill.), 659.

Illegal Contracts and Assessments—City Engineer's Powers—The attempt of city to assess property to pay for a city im-

provement in any way not provided by statute is illegal and void. Nor can a city make a contract for a public improvement which it has no authority to make, and any attempt to carry out such contract may be enjoined.. The statute does not authorize the city engineer to determine the character of the improvement or the kind of materials to be used. City of Bluffton vs. Miller. 70 N. E. Rep. (Ind.), 989.

Joint Assessment on Lots—Where two lots are appropriated to use as one parcel there is no error in assessing them as one lot, whether improved or not. Hill vs. O'Meara Const. Co. vs. Sessing Sons, 80 S. W. Rep. (Mo.), 747.

Remonstrance, Sufficiency—Signers—To render a remonstrance against an improvement peremptory it must be signed by two-thirds of the property-owners residing upon lots abutting on such improvement and such resident owners must own two-thirds in length of the abutting property to be improved. Maley vs. Clark, 70 N. E. Rep. (Ind.), 1005.

Sewers, Abandonment—When a city has established a drainage system it may not abandon it when it leaves the property-owners in a worse condition than they would have been had no such system been inaugurated. McAdams vs. City of McCook, 99 N. W. Rep. (Neb.), 656.

Council Can Construct Sewers and Assess Cost.—The statute especially confers upon the common councils of cities power to construct sewers and to assess the cost therefor against the real estate benefited. The power thus conferred carries with it the authority to construct all useful and necessary appurtenances, such as manholes, drains, etc. The connection of such sewers with private premises does not invalidate the proceeding on the ground that the improvement is a private one. Where an assessment has been approved by the council, having jurisdiction, it is binding until set aside in some direct proceeding. Bryce vs. Tuhey, 70 N. E. Rep. (Ind.), 531.

Sidewalk Assessment. Cost Required.—Under the statute providing that sidewalks shall be constructed by the city and paid for by special assessment, if the property owner does not elect to construct his own sidewalk, it is necessary to file an itemized bill of the cost of construction. Failure to file such a bill invalidates the special assessment levied to pay for such sidewalk. Miservey vs. People, ex rel. Hanberg. 70 N. E. Rep. (Ill.), 678.

Repeal of Act Invalidates City Ordinance Under It.—The repeal of an act authorizing the assessment of benefits by the front foot rule invalidates a city ordinance passed in pursuance of such act. An ordinance authorizing the levying of a special assessment according to benefits will not have retrospective effect unless so provided. Martin vs. City of Oskaloosa, Hedge vs. same. Ross vs. same. 89 N. W. Rep. (Iowa), 557.

Street Improvements Must Be Assessed on Both Sides of Street.—An assessment for a street improvement must be taxed against the lots on both sides of the street, even though the street is improved only on one side. An assessment of only one side is void. Klein vs. Nugent Gravel Co. 20 N. E. Rep. (Ind.), 801.

Street Grading. Removing Trees.—The city, when grading a street, may remove shade trees within the roadway without being liable therefor. Colston vs. City of St. Joseph. 80 S. W. Rep. (Mo.), 590.

Conflict of Lighting Companies in Montgomery, Ala.

Judge A. D. Sayre of the city court of Montgomery, Ala., on June 6, dissolved the temporary injunction restraining the Citizens' Light, Heat and Power Company from stringing its wires on Dexter-ave., although he held that the complaint of the Montgomery Light and Water Company was not without equity. The Montgomery Light and Water Power Company secured the injunction on the ground that its business was interferred with and further, that the resolution under which the Citizens' Company was stringing its wires was illegally passed by the City Council. The Citizens' Company moved to dismiss the bill for want of equity, which Judge Sayre overruled. Judge Sayre holds that too much stress has been laid on the claim of illegality of the Council's action because of the votes of certain aldermen who are interested in the Citizens' Company. He points out that the resolution had not been signed by the Mayor and consequently was without the range of consideration.

The Citizens' Company will proceed with its work unless the injunction is reinstated or the case is appealed.

Berwyn, Ill., Citizens Must Put In Officially Designated Water Meters.

Judge Brentano refused June 8 to grant an injunction restraining the village of Berwyn, Ill., from interfering with the water supply of the citizens, whose petition for an injunction arose out of an

ordinance passed by the board of village trustees March 26, 1903, adopting the water system. According to Judge Brentano they will now have to install the water meters officially designated by the board of trustees or permit the shutting off of their water supply.

Atlantic City's Garbage Contract Set Aside.

The Supreme Court of New Jersey handed down a decision, June 7, setting aside the contract entered into between the city of Atlantic City and the Atlantic Farms Company, last December, for the collection and destruction of garbage for a term of ten years at an approximate cost of $248,000. Mark Townsend of Linwood, a bidder for the contract, instituted the proceedings. The court held that the city council had no legal right to make the award for a ten years' term. The suit was instituted before the Farms Company began the erection of the plant with which it was to carry out its contract, and which was to cost about $100,000. The plant was completed and approved by the Councilmen, health directors and board of trade delegations. The city may arrange, however, to buy the new plant.

Indiana Cities Cannot Evade Debt Limit Through Dummy Water or Light Company.

The Supreme Court of Indiana handed down an opinion, June 3, reversing the judgment of the Dekalb Circuit Court, which refused to enjoin the town of Waterloo from taking stock in a company organized to furnish water and electric lights for the town and guaranteeing rentals which should pay the interest on the new company's bonds. The town was so heavily indebted that it could not issue its own bonds for the necessary $24,000 to build the plant, so a "dummy" corporation, as the Supreme Court term it, was organized. The town of Waterloo was to issue bonds for $5,500, the limit of indebtedness it could lawfully incur, and invest the money in stock of the company, and the company was then to issue bonds for the remainder of the money necessary to pay for the water-works and electric plant. The town bound itself to pay $1,350 a year for 50 hydrants, and $570 a year for 23 arc lights, the rentals to be used exclusively for the payment of interest on the bonds and to create a sinking fund to redeem them. The Supreme Court disapproved the scheme for obtaining water-works in this way. Judge Monks, speaking for the court, said that this was a mere subterfuge for borrowing on the credit of the town, in the name of a corporation owned and controlled by the town, money which the constitution forbade the town itself from borrowing. He says that the constitutional prohibition against incurring debts in excess of 2 per cent of the taxable property in a town or city "is absolutely and unqualifiedly prohibited, no matter what the necessity, pretext or circumstances (except in case of invasion or public calamity) or the form which the debt may assume. It curbs the power of the Legislature, the officials and the people themselves."

The court further holds that the statute permitting a town to invest in the stock of a water-works company does not apply to this case, because the Waterloo company was both a water and electric light company, besides being a mere "dummy" to stand between the town and the construction company, whose officials owned all the stock subscribed by any one other than the town.

New Orleans Drainage Board Recovers for Substitution of Cheaper Cement.

The jury commission of the United States Circuit Court rendered a verdict in favor of the New Orleans Drainage Board, May 23, for $28,390, with legal interest from judicial demand until paid. The object of the suit was for the reimbursement of the difference in price between the high-grade cement required by the specifications for the sewerage and drainage work and the inferior cement which was substituted by the National Contracting Company.

The contract for the work was awarded in 1897, and as it was to be of a permanent character, intended to last for a century or more, the quality of the cement was of so much importance that it was required in exact terms to be of the best quality of Portland cement possessing specified qualities when submitted to tests usual for determining the quality of cement. Soon after the work of construction was begun the drainage commission's chief engineer, without consultation with the drainage board, made arrangements whereby a cheaper cement was substituted by the contract for the specified cement, adding largely to the contractor's profits but with no reduction

of price or corresponding benefit to the drainage commission. When the facts were learned and the charge brought to the chief engineer he made a confession of its truth and exonerated the commission of any knowledge whatever regarding the substitution. He sought to justify himself upon the plea that he had exercised his professional judgment and had given the commission a better cement than was called for by the contract, and that what the city got in quality should compensate it for any difference in cost. In trying the case no charges were made derogatory to the character of any person connected therewith. The decision stated that "the engineer had no authority to allow the substitution of the one cement for the other. In law he had no right to permit the change. Of course, in every contract of this kind the engineer has a discretion, within reasonable bounds and limits, as to how the contract shall be carried out. But such discretion did not authorize the engineer to allow the substitution which took place in this case."

SEWAGE AND GARBAGE DISPOSAL

Septic Tank in Ohio—Sewage Disposal at Plainfield—Refuse Destruction at Shoreditch—Chicago Public Work.

The Use of the Septic Tank in Ohio.*

By R. Winthrop Pratt, Engineer, Ohio State Board of Health.

In most localities in the State of Ohio the geological conditions are such that no sand or gravel, suitable for sewage purification, can be obtained without transporting it over long distances, making the cost prohibitive.

To these conditions is largely due the fact that, since about the year 1897, when the septic tank began to be so much in evidence, nearly every proposed sewage purification scheme has included a septic tank as a means for reducing the area of necessary filtering material. The Ohio State Board of Health has in some cases approved these plans just as they were submitted, and, in other cases, where a high degree of purification was necessary, has required the addition of a certain amount of filtering material in order not to place too much dependence upon favorable action in the septic tank.

There are now in use in this State, by cities, villages and public institutions, 26 sewage purification works, while 18 more will probably be in use in the near future. Of the 26 plants now in use 5 cities and villages, 3 public institutions and 1 manufacturing establishment use the septic tank; and of the 18 cities and villages having proposed plans 14 will use it.

Nearly all of the systems now in use have a storage or flush tank of some kind, in which more or less septic action occurs, but those here mentioned are all designed strictly as septic tanks, and their construction permits of obtaining full benefit, according to theory, from whatever favorable bacteriological action may take place in them.

In no cases are sufficient chemical and bacteriological data available to accurately judge of the efficiency of these tanks, but they have all been inspected from time to time, and a few chemical samples have been taken. As far as can be learned, the tanks continue in use for from 1 to 2 years without decreasing more than 25 per cent in capacity. The "matte" formed on the surface varies from nothing to 1 foot in thickness. Both surface and bottom accumulations appear to remain fairly constant in volume in each case as long as the conditions of operation remain the same.

The odor from the tanks is often no more objectionable, if as much so, than that from the average settling tank; but

*A paper before the Boston Society of Civil Engineers from Jour. Asso. Eng. Soc.

in some cases very offensive odors are created.

We have then little uniformity in the degree of usefulness of the septic tank, and this strongly emphasizes the fact that not only should all conditions be carefully studied and made as favorable as possible before designing a tank, but that after the tank is in use it should be carefully watched and tested, in order to determine the most efficient mode of operation.

East Cleveland is a residential suburb of the city of Cleveland, having a separate local government. The population has increased from 1,000 in 1895 to 6,000 at the present time. In 1898 and 1899 a separate system of sewerage was built and designed to drain nearly the whole town. The domestic sewers are provided with underdrains, but, nevertheless, there is at times a large amount of leakage into them; this leakage is probably increased on account of the storm sewers being laid above the domestic sewers. There are now 40 miles of domestic sewers which receive the sewage of over 5,000 people, but no manufacturing wastes. The dry-weather flow is from 300,000 to 400,000 gallons per day, but increases to more than 1,000,000 gallons in wet weather.

A system of sewage purification was installed in 1899 according to the plans of the City Wastes Disposal Company of New York, which plans provided for the continuous filtration of the sewage; first, downward through egg-sized slag; second, upward through similar material; and third, downward through "aerators" or filters of small-sized "pea" coke. All filters receive continuous forced aeration furnished from a blower in the pumping station. The rate of application to the first filter was 10,000,000 gallons per acre per day, and the rate through the entire area of filtering material was 660,000 gallons per acre per day.

This system was used for about two years, but it was found that the filtering material needed frequent cleaning at great expense, due, it is said, to the increase in the volume of sewage and to the clay and other irreducible matter reaching the works in wet weather. Therefore, late in 1901, the plant was increased along the same lines, and in addition a septic tank was built for preliminary treatment of the sewage. This tank is of brick masonry, 24x87 feet and 11 feet deep. It is covered by a wooden pitched roof, the top of which is 9 feet above the level of the sewage. Sewage enters at mid-depth through openings, 6 inches square, equally spaced across one end, and is drawn off through horizontal slots, 12 inches by 2 inches, equally spaced across the other end. The tank holds 170,000 gallons, or 10 hours' ordinary flow. The horizontal velocity is 1.8 inches per minute.

After one year's use the tank was said to contain a scum less than 2 inches thick while the solid matter at the bottom was 2 feet deep. It has now been used about 1 year since cleaning, and contains about the same amount of material as at the end of the first year.

Chemical analysis of composite samples collected by the attendant in April, 1903, show no marked changes in the composition of the sewage during its passage through the tank.

However, since the enlargement of the works and the introduction of this tank, it has been necessary to wash the filtering material less frequently, and the effluent from the works is clear and odorless and produces no nuisance. A few chemical analyses have been made of this effluent, which show it to be well purified.

The odor from the septic sewage, as it flows onto the filters, combined with the odor from the clogged filtering material, is offensive, and causes more or less complaint on the part of the nearest residents.

The cost of the tank was about $3,000, while that of the entire plant was $66,000. The annual cost of maintenance is $3,000.

The system of sewage purification at Kenton, also designed by the City Wastes Disposal Company, is septic treatment, followed by intermittent filtration through "pea" coke covered by broken stone.

Though Kenton has a population of 8,000, the sewage of only 400 people is conveyed to the purification works. The daily flow is about 25,000 gallons, all of which is domestic sewage except the surface water, which is admitted through 2 catch basins.

The septic tank is 28 feet long, 16 feet wide and 6 feet deep, holds 21,000 gallons and is covered by a wooden house. Sewage first passes through a small grit chamber and then enters the tank 2 feet below the surface and is drawn off through small openings, at the other end, at the same depth. It then enters one of the 3 "dosing" filters, which are flush tanks, filled with broken stone, and which discharge intermittently onto the filter beds.

These beds consist of 3 parallel open tanks, each 10x100 feet, and filled with a layer of "pea" coke 18 inches deep at the upper end and 4 inches deep at the lower end. The coke is covered with broken stone. The beds have a sharp slope away from the septic tank, so that each dose of sewage flows through them laterally with a kind of wave motion; the idea being to obtain as much aeration as possible and at the same time keep the sewage from appearing on the surface of the filters.

The septic tank is divided longitudinally, so that one-half can be used. The whole tank, however, has been in use ever since the plant was first operated in June, 1902, thus making the septic period from 20 to 24 hours. There was, after 15 months of operation, about 1 foot of sludge in the bottom of the tank and no scum whatever on the surface. However, when storm water is brought in by the sewers a scum quickly forms, but soon disappears when the flow of storm water ceases. It has not yet been necessary to clean the tanks.

Very little odor can be noticed around the plant, and I found, upon entering the house over the tank, after it had been locked for several weeks, that the odor inside was not in the least offensive; in fact, it was much less than that arising from any settling tank that I can recall.

There is no doubt that the tank is successful as a sludge destroyer, but the subsequent treatment has not yet been studied sufficiently by the writer to justify a definite statement as to its efficiency.

The largest system of septic tanks and contact beds in the State of Ohio is located at Mansfield, and has been in operation about 2 years.

Mansfield has a population of about 20,000, but only about 9,000 are connected with the sewers. A considerable portion of the sewers were built some years ago and received much surface and ground water. An overflow, however, is placed in the trunk line, so that not more than 1,000,000 gallons per day can reach the purification works, and this is the average amount treated. As would be expected, sewage under these conditions is quite weak. The main sewer discharges into a grit chamber at the pumping station, where the sewage is screened and pumped continuously to the septic tanks, from which it is drawn off at a point about 3 feet below the surface.

There are 4 tanks, having a total capacity of 1,000,000 gallons, or about 24 hours' flow, and all 4 are used. By means of floating orifices the discharge from the tanks is kept constant, regardless of the flow into them. This may cause a daily fluctuation in the surface of the liquid in the tanks of about 6 inches.

Aeration of the septic effluent is obtained: first, by its drop into a collecting channel; and, second, by its passage over aerating steps.

The aerated sewage is then applied through automatic apparatus to contact beds, 5 in number, each ¼ acre in area; and the effluent from these beds is discharged into a small stream.

The plant is well removed from any dwellings, and the septic tank is ventilated into the stack at the pumping station. There is no objectionable odor around the plant. One of the tanks, after 1½ years' use, was drawn off and only a few inches of deposit found in the bottom. No surface scum has formed to any extent in any of these tanks.

The final effluent appears clear and odorless, and tests have shown that the entire process removes from 80 to 90 per cent of the organic matter, as shown by the albuminoid ammonia and oxygen consumed, and from 98 to 99 per cent of the bacteria.

This plant, as well as the ones at Trumbull County Infirmary and Soldiers' Home at Sandusky, was designed by Snow & Barbour, of Boston.

The population of the Soldiers' and Sailors' Home at Sandusky is 1,400 to 1,500, and the quantity of sewage is about 100,000 gallons per day. The sewage is strong.

There are 2 septic tanks, each 26x40 feet and 7 feet deep; either one or both can be used. When one only is used sewage remains in the tank 12 hours, and when two are used it remains twenty-four hours.

After passing through a grit chamber and screen the sewage enters the tank three feet below the surface and leaves at the same depth at the other end. It is then aerated by passing through about 100 feet of galvanized iron gutter about two inches deep, from which it overflows in thin streams or sheets and is conveyed into a flush tank.

The flush tank discharges automatically upon intermittent sand filtration beds about one and one-fourth acres in extent. The sand used in these beds is about four feet deep and of very favor-

able size and quality for sewage purification.

The tank has been in operation some eight or nine months. A heavy scum of a foot or more has formed at the surface and there is more or less of a deposit at the bottom. The tanks have not been cleaned, however. At the beginning both tanks were used, but the septic effluent proved to be so offensive that it was objectionable to the occupants of houses 600 to 1,000 feet distant. One of the tanks, therefore, was cut out of service, and since then the odor of the septic sewage has been less objectionable.

The septic tank effluent contains much finely divided matter, which is deposited in the aerating gutters, and has to be removed frequently. Originally a strainer of broken stone was used before the sewage entered the flush tank, but this strainer became so quickly clogged that its use has been discontinued.

The final effluent from the sand filters has been well nitrified and of very satisfactory character.

The Trumbull County Infirmary, near Warren, has a population of about 100. The sewage is purified by septic tank and intermittent filtration through coke. The tank is fifteen feet long, five feet wide and five feet deep, and holds 3,000 gallons, or a little more than one day's flow. There is no screen of any kind at entrance to the tank. The sewage enters and leaves a short distance below the surface. The tank effluent, after passing over aerating steps, is collected in a reservoir of 4,000 gallons capacity, from which it is pumped daily to the coke beds.

These beds contain four and one-half feet of fine coke, and the average amount of sewage treated by them is 60,000 gallons per acre per day, applied daily, in doses of 2,500 gallons, lasting about one hour. The effluent appears in the underdrains in about thirty minutes after the sewage is applied. It is clear and odorless, and analyses have shown it to be well purified.

The sewage of this institution is unusually dilute, due to leakage, which at times is so great as to necessitate the discharge of raw sewage directly into a small stream.

During its four and one-half years of operation this septic tank has been cleaned but once. The sludge in the bottom retains a constant depth of about one foot and the scum is 3 or 4 inches thick. The long septic period and subsequent storage in the reservoir does not seem to prevent satisfactory purification.

The odor is very strong, but is largely confined to the small wooden pump house over the tanks, which is ventilated into the stack at the boiler house. The iron of the pump has been attacked by gases from the tank. This system of ventilation, however, enables the tank to be located near the institution buildings without causing a nuisance.

The shops of the Lake Shore and Michigan Southern Railroad employ 500 hands, and are located in the center of the village of Collinwood.

A system of sewage purification, consisting of septic tank and coke contact beds, was constructed in 1902. Both tank and contact beds are covered, although trapdoors are placed over the latter and are usually kept open. No definite information is available any more than to say that it apparently purifies the sewage well enough to avoid polluting the small stream into which the effluent is discharged, and that no objectionable odors are complained of either by the employes of the shops or by occupants of houses a few hundred feet distant. It is understood that no cleaning of either tank or contact beds has been necessary during its 18 months or more of service.

Tanks are also now in operation at Delaware and Westerville, but at these places the works have been in but a short time and accommodate only a few hundred people.

Sewage Disposal at Plainfield, N. J.*

By Andrew J. Gavett, Plainfield, N. J.

The city of Plainfield, with a population of about 18,000, is situated twenty-four miles from New York City. A sewerage system was constructed by the city in 1895, separate sewers being used for storm water and for sewage. The sewage was originally discharged on intermittent sand filters; but, in 1901, septic tanks and contact beds were constructed and since that time the sewage has been treated by the new works. There are now 1,775 sewer connections, 275 having been added during the past year, and the flow of sewage has nearly doubled since the new purification works were started, being now about 800,000 gallons per day, which increases to over 1,000,000 gallons at times of high ground-water.

*A paper before the Boston Society of Civil Engineers, from the Jour. Asso. Eng. Soc.

It is proposed to examine and repair some of the sewers in the wet district as soon as the weather will permit, and plans for enlarging the disposal plant are also under consideration.

The disposal plant consists of 2 septic tanks, side by side, under one roof, and a double set of bacterial contact beds, 8 in all; the new works are located 200 feet from the nearest streets and the sewage does not appear on the surface until discharged into the brook.

The septic tanks are each about 50 by 100 feet and 7 feet deep, the water rising 6 feet above the bottom. They contain about 450,000 gallons of sewage and with the average flow the sewage is 13 hours in passing through the tanks. After leaving the tanks the effluent passes over a weir in a thin sheet and falls into a channel, the weir and channel extending the full length of each tank, 100 feet in all.

The contact beds are in 2 sets of 4 each, the first set being 5.42 feet higher than the second, each bed having an area of 9,750 square feet and a total depth of 5 feet. In the upper set of beds the working material is trap rock, 3½ feet deep, varying in size from ¼ to 1½ inches, and in the lower set slag is used in some beds and cinders in others, somewhat smaller in size than the stone in the upper beds. The bottom 6 inches and the top 12 inches of all the beds are composed of 2½-inch stone; in the former are the horseshoe drain tiles and in the top foot of the material (into which the sewage is not allowed to rise) distributing pipes are laid, consisting of vitrified sewer pipes from 3 to 12 inches in diameter, laid with open joints, except the 12-inch pipes, which are cemented. The partially purified sewage passes continuously from the septic tank to a gate chamber at the intersection of the division walls of the first or upper contact beds. Here it is diverted by wooden gates to each of the 4 beds in succession. After flowing into one bed for 2 hours the sewage is turned to the next bed, each of the 4 receiving the flow in turn. The sewage in the first bed, after being retained for 2 hours, is drawn off, and passes through a pipe to the gate chamber of the second set of contact beds, where the same process is repeated. After the period of rest in the second set of beds, the effluent is turned into the brook. Each bed receives a rest of 2 hours before each filling, and 2 hours each are allowed for filling and for emptying; the material in the beds is sufficiently coarse to allow the air to be drawn down to the bottom of the beds at each emptying.

The sludge accumulates very slowly on the bottom of the tanks, but the scum gathers more rapidly, and is removed, about three times a year, through the sludge pipes to a sand filter bed, after as much as possible of the clearer middle water has been run off onto other beds, separate valves and pipes being provided for this purpose. When the sludge is running from the tanks a deodorant is added, either strong limewater or permanganate of potash, the latter being preferred.

During one period of 5 months, including winter weather, the scum increased about 1.25 feet, making, in both tanks, 463 cubic yards; after this was sufficiently dried to be piled up it measured 130 cubic yards. In the following warmer 5 months the scum amounted to about 1 foot in average depth. These figures are only a rough approximation, as it is difficult to measure the varying thickness of scum in the septic tanks. The flow of sewage during this time was about 650,000 gallons per day, this quantity being at times much increased by ground water.

The sludge is allowed to dry out on the sand beds and is used as a fertilizer on them and on other parts of the property, on which good crops of sweet and yellow corn are raised.

The temperature of the sewage and effluent is nearly constant; recently, when the temperature of the air was 10 degrees below zero, that of the sewage was 56 degrees, the effluent from the septic tank 55 degrees and the final effluent 53 degrees. Since then, during a time of much ground water, the temperature of the final effluent fell to 49 degrees, but afterward returned to the normal temperature.

The effluent from the works has been satisfactory and there have been no complaints from the adjoining owners or residents since the present works were installed. The New Jersey State Sewerage Commission, in its report written in 1902, states that "87 per cent. of the bacteria were removed and the putrescible matter completely disappeared."

Analyses in the spring of 1903, by Mr. L. R. Thurlow, Health Officer of the Plainfield Board of Health, gave the bacterial efficiency of the septic tanks as 55 per cent., and of the whole plant as 87 per cent.; the efficiency of the septic tanks, as shown by the removal of albu-

minoid ammonia, was 38 per cent., and by oxygen consumed 44 per cent. Mr. Thurlow gives the efficiency of the whole plant as 90 per cent. by the removal of albuminoid ammonia and 86 per cent. by oxygen consumed. He believes that the plant is doing better work now.

The works are operated by hand, requiring the services of one day man and one night man, who are paid $67.50 and $45 a month, respectively; additional labor costs about $15 a month.

The cost of the plant, exclusive of land and engineering services was $38,750.

Refuse Destruction at Shoreditch, London.*

By C. Newton Russell, Borough Electrical Engineer, Shoreditch, London, England.

The main object of this paper is to treat the practical side of the question of refuse destruction rather than the various types of destructors, and as full particulars and statistics may be derived from printed publications, the author proposes to describe fully the works with which he is associated. The plant in question is owned by the Metropolitan Borough of Shoreditch, London, and was opened in June, 1897. The works were about the largest of their kind, and contained many new features, some of which even now are subject to criticism. Before the works were built most of the domestic and market refuse was carried in barges by the canal which passes through the Shoreditch area and dumped on waste land in close proximity to the London suburbs. The problem of dealing with the refuse under the new conditions was entrusted to Mr. E. Manville, of the firm of Messrs. Kincaid, Waller & Manville, consulting engineers of Westminster, and the contractors, who erected the destructor, were Messrs. Manlove, Alliot & Co., of Nottingham.

The Shoreditch area which adjoins the City of London contains 640 acres, and had in 1897 a resident population of 124,000. Land was very valuable, and it was necessary to purchase and pull down all property near the center of the area in order to obtain a suitable site. Eventually a suitable place was purchased, upon which was erected an electric generating station, refuse destructor, baths and wash-houses, and a free library. The area allotted to the destructor works was 13,450 square feet, costing about 12s. per square foot. The space at disposal being so limited, it was impossible to have an inclined roadway, up which the wagons loaded with refuse could be taken to be tipped directly on the top of the furnaces, which is the usual practice. It was therefore decided to put in lifts, to raise the refuse to the top platform. The destructor and boiler-house is separated from the electricity generating station by fire-proof doors.

The destructor house contains two batteries of three Babcock-Wilcox water-tube boilers, each having two refuse furnaces (one placed on either side of the boiler), while the ordinary coal fire-grate immediately under the boiler tubes is provided as an auxiliary for use if required. A complete set thus consists of one boiler and two furnaces. The hot gases from the refuse furnaces pass through short side flues and immediately come in contact with the boiler tubes. The gases, after passing round the boiler tubes, find their way into one of the main flues, then to the economizer, and thence to the shaft. The grates of the refuse furnaces are five feet wide and five feet from front to back, and are inclined at twenty-five degrees to the horizontal. The refuse furnace bars are of the stationary type, and are built up of wrought-iron wedge-shaped strips in sections two feet six inches long by three and one-half inches wide, and about four inches deep. The grate area of each boiler furnace is 27 square feet, the heating surface being 1,300 square feet.

The refuse, when received at the works, is shot into one of two lifts, each provided with a tipping-truck, which is run off the lift as soon as it reaches the top platform; the truck runs upon rails and is operated on the trolley system. The refuse is then tipped into special charging trucks, worked by chain gearing, one of which is provided for each furnace.

The average amount of refuse received per day is about eighty-five tons (one ton, 2,240 pounds), and this is delivered between 9 a. m. and 5 p. m., but the amount varies considerably; in summer it may be as low as 60 tons, and in winter as high as 140 tons. As it is found impossible to get the supply at a regular rate, it is advisable to provide storage space to cope with extra large deliveries. This is done at Shoreditch, where a large rectangular iron storage bin, holding about sixty tons of refuse, is fixed under the tipping platforms.

The lifts and tip-trucks are worked en-

*From a paper at the annual convention of the American Society of Mechanical Engineers.

tirely by electricity and are found to act well. The average amount of electric energy consumed by the lifts and trucks, taken upon a total of 25,000 tons of refuse (over a year's working), is 0.52 kilowatt-hour per ton, the greater portion of which is expended on the lifting operation. The record time taken to deal with a load of refuse shot into the lifts, raised to the top platform and tipped, and the empty truck returned to the starting point, is seven minutes, the average time being nine minutes. This is an important factor in considering new plants, as unless sufficient lift accommodation is provided a considerable loss of time results from keeping the dust vans waiting. It is found that the vans in which the dust is collected usually arrive in batches, and unless ample provision is made for rapidly shooting the garbage delay occurs. The cost of repairs to the lift and tipping-truck part of the equipment is very small.

The charging trucks are of the square-box pattern, made of mild steel, of sufficient capacity to hold one cartload of refuse, and are divided vertically into five compartments. Each compartment holds about 500 pounds, the usual amount of one charge of the furnace. The charging-door, or opening, is of the horizontal pattern, and is operated from the top platform by chain-gearing, worked by hand.

To charge a furnace the truck is drawn into position so that one of the compartments is immediately over the horizontal door; the act of opening allows the false bottom of the truck to fall, and the refuse drops into the back portion of the furnace. However, as the refuse is not sorted in any way, but is dealt with exactly as it is received in the van, it occasionally happens that large articles, such as bags, boxes, tins, etc., prevent the whole of the charge from falling at once on to the drying-hearth, in which case it has to be pushed down with rods. The charging trucks enable ordinary refuse to be passed from the carts to the furnace without handling, and are of the kind in use at Liverpool and other places which are worked on Messrs. Boulnois and Brodie's system. It is not found advisable to employ this system of charging for straw, paper, sawdust, or any such light and inflammable material, owing to its tendency to catch fire during the operation of charging and before it can be shot into the furnaces. It is found more convenient and safer first of all to shut off the air-blast and feed the refuse in question through the front of the furnace, the blast being turned on again when the grate is well covered. Each furnace is provided with both steam-jet and forced air blast. In the author's experience the latter has been found preferable.

The forced-air blast is provided by three Sturtevant fans, each designed to give 8,000 cubic feet of air per minute, and driven direct by a shunt-wound electric motor at a speed of 650 revolutions per minute. The three fans are not used continuously, the full number being only put to work during the time of heaviest load. The inlets to the fans are connected with air-ducts, that draw the hot air from the top platform of the destructor; the three fans are connected to a common discharge-duct, which is led underground to the ashpits, the draught to each being controlled by a separate air-valve. The air-pressure in the discharge-duct at the fans is three inches head of water, while that in the ash-pits is slightly less than one inch. Even with the latter comparatively low pressure the temperature obtained in the furnaces often exceeds 2,000 degrees Fahr. It is interesting to note the comparatively great amount of energy (four units per ton) absorbed by the electrically driven fans, a matter which is open to improvement. The works are run on the eight-hour shift system, seven days per week, so that some of the fans are always at work; in fact they run for weeks without a stop. A direct-coupled, electrically driven fan is an ideal arrangement from a mechanical point of view, and one which experience shows to require very little attention.

In order to give an indication of the temperatures reached in steam-raising destructor plants, the author has collected from time to time a number of articles which have passed through the furnaces, from which it appears that such metals as cast steel, cast and wrought iron, copper, brass, etc., frequently reach a molten state. The furnaces have now been in daily use for six years, and it is interesting to find that the fire-bars are even now in good condition, and show very little sign of deterioration.

The fire-brick linings of the furnaces are found to last well, and do not often require renewing; repairs are occasionally necessary in connection with the fire-brick arches, principally on account of damage done by stoking irons. A somewhat novel system of storing hot feed-

water is in use (sometimes called thermal storage). The reason that led to its adoption was that, at the inception of the combined scheme, it was not thought that for some time at least the demand for electric current would be very great, and that during the hours of daylight, when refuse was of necessity being burned, it was feared that some of the heat would be lost, owing to the small demand for steam.

It was therefore decided to install Halpin's Thermal Storage system, with a view of storing up heat in the form of water at a high temperature. The storage vessel was originally connected to the main line of steam pipes, with a view to it being gradually filled by pumping in cold feed water, which would be heated by means of spare heat generated in the refuse furnaces during the daytime. The intention was that a portion of the steam raised in the boilers of the destructor plant would be used as required for the engine driving the electric generators, and the balance passed over to the thermal storage vessel, where it would part with its heat to the feed-water. The engines were designed to have adjustable cutoffs, so as to drive their full load with pressure varying from 200 pounds to 120 pounds per square inch. The object aimed at was to fill up the thermal storage vessel at times of low load with water of a temperature corresponding to a pressure of 200 pounds per square inch, and at the time of greatest demand for current, not only feed the boilers from the storage tank, but by the evaporation of the hot water as the pressure fell steam would be given off to augment that supplied by the ordinary boilers. The process would proceed until the pressure reached the lowest point, i. e., 120 pounds, by which time it was thought that the time of maximum demand would have passed, and that the ordinary boilers would be able to cope with the load. This accounts for the provision of heavy structural ironwork, which has since proved unnecessary, also the extensive system of steam mains. In practice things worked out very differently. First it was found that pumping cold water into the vessel into which high-pressure steam was being admitted caused such a water hammering that the practice had to be discontinued forthwith, and it was found necessary to partially heat the feed water by passing it through a Green's economizer before putting it into the thermal storage vessel; this, however, effectively got over the difficulty. Secondly, by the autumn of 1897 the demand for steam during the daytime had reached nearly the limit of heat it was possible to get from the refuse furnaces; so, having nothing to spare from that source, no additional thermal storage vessels were necessary.

The boiler-feed is now furnished by a Weir pump, which forces the cold water through a Green's economizer, where it is heated to a temperature varying with the load, although at light loads a maximum temperature of 250 degrees Fahr. has been reached. The feed then passes into the thermal storage vessel, fixed at a level of about 20 feet above the boilers. This vessel is simply a cylindrical shell, 30 feet by 8 feet, which is used for storing, during the hours of light load, hot water with which the boilers are fed directly by gravity.

Most of the lime in feed-water comes down in the feed-storage vessel; the amount taken out of the vessel after a run of seven months was little short of one ton after being dried. The deposit in the economizer tubes was less than 1-16 inch in thickness; it was of a harder nature than that in the feed-storage vessel, and could be removed by a scraper. The boiler-tubes were frequently examined and were found fairly clean, the deposit in the tubes amounting to an average of 3-32 inch.

This system of feed-storage has undoubtedly contributed considerably to the success of the plant generally; it enables the engineer in charge of the steam-raising plant to store hot feed-water during about eighteen hours out of the twenty-four, so that at the time of maximum load the vessel is about two-thirds full of feed-water at a pressure and temperature equal to that of the boilers. Tests have been made on several occasions, when the demand for electricity has been within the range of the refuse furnace to supply the necessary heat, and when, of course, no coal was used. The results showed 0.95 pound of water evaporated at a steam pressure averaging 130 pounds for one pound of refuse burned. A considerable reduction must, however, be made in these figures when taken over say twelve months. Damp weather (which affects the quality of the refuse), low barometric pressure, choked flues, warped doors, the starting up of furnaces, etc., may easily bring down the average results over a lengthy period to 0.5 pound of water for one pound of refuse burned. The existing vessel has, however, proved most serviceable for the storage of hot

feedwater, and as a means of removing the impurities from the feedwater before it reaches the boiler. The economizer was not erected until some time after the works were opened, as it was not anticipated that the temperature of flue-gases would warrant its insertion. However, after the plant had been running steadily for some time, and careful tests had been taken, it was found that the flue-gases at the base of the chimney had a maximum temperature of 700 degrees Fahr.

Adjoining the refuse destructor and electro-generating station are situated the public baths and wash houses, which contain:

1 swimming bath, 100 feet by 40 feet.
1 swimming bath, 75 feet by 34 feet.
76 slipper baths.
50 troughs for clothes washing.

The exhaust steam after leaving the engines (non-condensing) in the generation station is carried by a sixteen-inch pipe to the baths, where it is put through heaters which supply all the hot water necessary for the whole of this large institution. Live steam is also supplied direct from boilers for clothes boiling, etc.

This scheme for heating the whole of the baths and wash houses has proved eminently successful, and has excited a great amount of interest among municipal authorities. No charge whatever is made to the baths for any exhaust steam. A charge, however, of not quite $1,250 per annum is made for the live steam. The arrangement is a very economical one for the Baths Department, and worthy of serious consideration in cases where exhaust steam is available. The Free Library, situated close by, is heated by exhaust steam from the feed pumps.

The amount of refuse destroyed is between 25,000 and 26,000 tons per annum. The residue (or clinker) amounts to from 33 to 35 per cent of the weight. The cost for labor for burning the refuse is very high, compared with that at otner destructor plants, and is one of the most serious factors for consideration. The nearer a destructor is to the center of a large city, the greater will be the wage bill, and this fact must be borne in mind in considering any new scheme:

	Per ton. s.	d.
Cost for handling and burning refuse, including yard men—average	2	6
Clerks and establishment charges	0	4½
Repairs and maintenance of cells and plant and cost of engineering stores	0	10
Total	3	8½

The average number of men employed in actually handling the refuse (per shift of 8 hours):

Furnace men	4
Top men	3
*Lift men	1
*Yard men (laborers)	2
Foreman in charge of shift	1

*Daytime only.

The above figures are for the fifth year's working, when considerable repairs were necessary to the furnace, linings, doors, etc.

The works are run on the eight-hour-shift system, seven days per week.

The amount of electric energy consumed in the burning and handling of 25,000 tons of refuse is as follows:

	Units per tons.
Electric fans	4 0
Electric lifts and trucks	0.5
Total	4.98

The cost of the destructor, including furnaces, flues buildings, portion of cost etc ..... £15,000 or $75,000

The cost of chimney was £2,790, two-thirds of which was charged to the destructor and one-third to the electric generating department $13,950

The residue from London refuse consists of approximately:

	Per cent. of refuse.
Common clinker	30
Fine ash	5
Flue dust	0.5
Old tins and iron	0.5
Total	34

Chicago Public Work.

By Charles B. Maugham, Chicago.

Business in the building material line is gradually picking up with the advancing season. The demand is fairly satisfactory in nearly all lines. While the demand for cement shows a gradual improvement over earlier months in the year it is still far from expectations at this season. The price of cement is averaging in the neighborhood of $1.50. (Late in the month a price of $1.39 was quoted elsewhere in Illinois.—Ed.)

The last brick of the south arm of the intercepting sewer on the south side of Chicago was laid by Mayor Harrison on June 5 last in the presence of a large number of members of the City Council and many other municipal officials. It marked the completion of the most important section of the South Side drainage system, which was started in 1901, and which, when completed, will cost $5,000,000.

The sewer just completed is 4½ miles in length and has a diameter of from 16 to 12½ feet, and will drain 12,000 acres of territory. The main part of the drain will empty the sewage into the drainage canal. The sewer work has furnished employment to a daily average of 250 men and has taken 32,000,000 bricks, made at the Bridewell, the city prison. When the entire intercepting sewer system is completed practically pure lake water, so far as sewage is concerned, will be assured. The reversal of the flow of sewers from the lake into the river will keep from Lake Michigan 75 per cent of the original pollution, and as soon as the temporary pumping plant in the southern part of the city is started no sewers will be discharging into the lake in the section of the city taken up by business and residences. When the sewer system and the pumping plants are finished the entire cost will have been $5,000,000. The work on the sewer so far nas been done by the city of Chicago by day labor, no part whatever having been done by contractors. When all is done everything will have been paid for.

The financial committee of the city council of Chicago is planning to expend nearly three million dollars in extensive public improvements. It has instructed the corporation counsel to draft an ordinance for the issue of bonds aggregating $2,044,200. The expenditure will be for the following purposes:

Extension of the electric lighting system, $200,000; seventeen new fire engine houses, $298,200; new public baths in five wards, $75,000; retiring sewer bonds, approximately, $150,000; new police station, $20,000; miscellaneous construction, bridge repairs, etc., $400,000; five new bridges, $901,000.

The improvements have been demanded by department heads for a long time. The city council was unable to grant the funds until the State Supreme Court decided recently that the city could increase its indebtedness $7,500,000 more by the issue of bonds.

Col. O. H. Ernst, the government engineer for the Chicago district, has made a report to the war department recommending that the tunnels under Chicago River be lowered to the depth of twenty-six feet. As regards the tunnels which the city owns, he recommends that they be destroyed and new ones built. This will allow the river to carry 800,000 cubic feet a minute through to the drainage canal without making too rapid a current for the safety of navigation. The tunnels are to be constructed one-half at a time, by means of a coffer dam in the middle to allow of the opening of one-half of the channel by April 1, 1905. As to the work on the Van Buren-st. tunnel, owned by the traction company, Col. Ernst states that it can be rebuilt without interfering with the roof of the present one until after it is completed.

The efforts of the city to secure from the drainage canal board the use of the power from the drainage canal have so far failed. The plant will generate 30,000 horse-power. It was proposed that the drainage board sell this power to the city at the actual cost, $5, but the trustees decided that it could not let the municipality have it for less than $20 per horse-power, as it was obliged by the act creating the sanitary district to derive a revenue from its assets. At this price the drainage board would get annually from the city a profit of $450,000. Figures have been prepared by City Electrician Ellicott showing as follows: City street arc lamps, cost per lamp per year, $54.50; rented, $103 per year; cost of steam generation of light, per lamp, $29.00; electrical expense, per lamp, $25.50. The city owns and maintains 5,080 lamps and rents 674. Mr. Ellicott figures that $10.25 fairly represents the cost of producing the canal water power per horse-power, which would reduce the cost of electric light power from $29 to about $10.25 per lamp per year, and much of the power could be turned to pumping water during the day at a clear saving above this.

LIGHT AND POWER

Electric Railway Power—Cost of Street Lighting—Municipal Ownership in Chicago and Ontario—Northborough Lighting System.

Power and Power Transmission for Electric Railways.

The following discussion of the sources of power for electric railways, the amount needed and the methods of transmitting and applying it to the individual cars is taken from a paper by Robert P. Woods, M. Am. Soc. C. E. and Vice-President of the Indiana Engineering Society, which appears in the proceedings of the latter society. The paper is entitled "Interurban Electric Railways of Indiana," and contains the first table of statistics of equipment of interurban railways which has appeared. This table is too large to reproduce here, but can be obtained, with the paper and the accompanying diagrams in the volume of proceedings of the Indiana Engineering Society for 1904.

The prime movers employed on electric railways are the water turbine, the steam turbine and the steam engine. The efficiency of the water turbine is well established and satisfactory, and although there are numerous streams in Indiana that could be utilized as sources of power for interurban purposes, no applications have been made. The steam turbine is gaining in favor and although barely passed from the embryonic state, can be called successful. The only prime mover on interurban work in this State is the steam engine, variously designated as simple, compound, Corliss, non-condensing, direct connected, belt driving, or combinations of these. The electrical units connected to the engines are direct current, and alternating current generators. In connection with the latter, auxiliaries in the form of storage batteries are used. Batteries were introduced some eight or nine years ago and placed on the cars, making them self-propelling, but their great weight and excessive maintenance cost caused a change and they are now installed in the power and sub-stations on some railways to take care of the fluctuations of the load, and to take care of all the load in case of a breakdown in machinery.

There are two systems for distributing the electrical energy, the direct current and the alternating current. The difference between them is that the former deals with a "flow of energy already established," while the latter deals with the "starting and stopping of this flow." The former contemplates for traction purposes a maximum potential of 700 volts, and the latter at present 30,000 volts. In deciding which should be used, the energy required and the length of the line are the principal factors to be considered.

The direct current is limited in length to about twenty miles and this extreme distance only when the power station can be located midway of the length and near the load center of gravity of the line. In direct current distribution the energy passes from the generator to the feed wires, and thence to the trolley, or from the generator to the third rail, if the latter is installed in preference to overhead construction. The continuous current is usually supplied to the line at 550 to 650 volts.

The alternating current may be used for almost any length. Distances of over one hundred and fifty miles are recorded. On the Indiana Union Traction Railway there are sub-stations located sixty-one miles from the power station.

In the high tension alternating system a low potential alternating generator is generally employed. This low voltage alternating current passes from the generator to the oil or air cooled transformers, where it is stepped up to the highest voltage the line is to carry, thence to the transformers in the sub-stations, where it is stepped down to a low alternating current voltage, passing next through the alternating current switchboard to the alternating side of the rotary converter, where it is changed from alternating current to a direct current. From the direct current side of the converter it goes through the direct current switchboard with a potential of 600 to 700 direct current to the line conductors, which are the feed and trolley wires, or the third rail.

To supply direct current for the line

within the proper limit of distance from the power station, a rotary converter is installed therein. It is not necessary to place accompanying transformers as in the sub-stations, inasmuch as the alternating current is taken direct from the alternating current side of the converter, when the low voltage alternating current generator is used, and there converted to direct current, the subsequent action being similar to that when the direct current leaves the sub-stations.

The alternating current is carried on three wires from the power station to the sub-stations. When double transmission is used there are six wires.

The alternating current phenomena end when the current is transformed into direct current at the converters, for the working energy on the trolley or third rail is direct current. This has been necessary because the present car motors are direct current in type and only capable of utilizing a potential of 700 volts.

Recent experiments have demonstrated that single phase alternating motors can be used successfully. This will do away with rotary converters and consequently sub-stations. It will be necessary, however, to maintain transformers at convenient places on the line, but a constant attendant will not be necessary. The alternating current will be carried on the trolley wire instead of direct current. This method will probably be employed on the Rushville division of the Indianapolis & Cincinnati Traction Railway, which is now under construction.

Transmission lines are either the overhead trolley or the third rail. The former antedates the latter, is better known and more generally used. Either, as previously noted, conveys direct current only.

The trolley may be one or two copper wires, located from seventeen to twenty-two feet above the center of the track on a bracket or on cross suspension wire. When there are two trolley wires, the cars going in a given direction use one wire, while cars going in the opposite direction use the other. Three common shapes are the circular, figure eight, and general electric grooved.

The third rail is a low carbon steel tee rail, and has a resistance about seven and one-half times that of copper. It is rolled to any size, generally from thirty to one hundred pounds per lineal yard, and is located about twenty inches outside of, and seven inches above the track. The current is conveyed to the car motors by way of two contact shoes so adjusted on the car as to brush along the third rail.

At highways, lanes and railroad crossings the third rail is omitted and the car drifts over these gaps. This is necessary because of the danger to pedestrians and live stock. The rail ends are connected by means of underground cables.

The high tension alternating current on all third-rail railways is transmitted on overhead wires in a manner similar to those of the overhead trolley lines. It is a disputed question which is the better system of transmission. The advocates of the overhead trolley claim it has been successfully used and has given good satisfaction, and that the third rail gives trouble when coated with ice; is objectionable because lights are out while power is off in passing the highway and railroad gaps; is dangerous to life and expensive. On the other hand, third-rail advocates claim the trolley has not given good satisfaction, especially for high speeds, and the second, third and fourth objections are nearly eliminated and the one of expense does not exist. They further claim the third rail is more substantial and costs less to maintain. There are no third-rail systems in Indiana; all are overhead trolley.

The conductors for conveying the high tension alternating current and the feed wires are either copper or aluminum. The electrical conductivity of the former is 98 and of the latter 61. The trolley wire is always copper and the third rail is a low carbon steel.

A more definite idea of the primary factors entering into the determinations for the power and equipment required on interurban electric railways may be obtained by considering a few formulae.

The power required at car axles may be approximately calculated from:

$$\text{Total H. P.} = \frac{Wn\,(GS+TS) + Wn'' \times TS'}{33000} + HN.$$

W—Weight of each car loaded in pounds.

N—Total number of cars.

n—Number of cars on up grades.

n′—Number of cars on down grades.

n″—Number of cars on level.

G—Average grade per foot.

S—Speed in feet per minute on up grades.

H—Estimated H. P. per car for heating.

T—Traction coefficient, or power required on level track to move a loaded car in pounds per ton.

The Westinghouse Electrical Company

assumes between 20 and 30 pounds per ton on a level with 20 pounds per ton additional for each per cent. of grade. About 20 or more per cent. should be added to the result obtained for loss of power in the car equipment and in transmission from the power station to the car. Again, as the foregoing is for average load, a fluctuating load should be provided for by adding an additional 15 to 50 per cent. to last result.

Another approximate formula for similar results expressed in kilowatts is:

$$\text{Total average energy in K W at the cars} = \frac{N \times W \times S \times K}{1000}$$

N—Number of cars.
W—Weight of loaded car in tons.
S—Speed in miles per hour.
K—Energy in watt hours per ton mile.

For total energy at power station add about 20 per cent to the result obtained for losses in line transmission and in car equipment, and since the maximum load is often 25 to 50 per cent more than the average load, such increase should also be added. Where storage batteries are installed the last additional per cent may be as low as 15 per cent.

The energy in watt hours per ton-mile varies from 75 to 100 watts. Seventy-five to eighty-five watts may be allowed for the limited, and 90 to 100 for local cars.

It is the practice now to install power stations with a reserve unit to permit of repairs without interfering with the operation of the road. For example, if 1,500 kw. energy is required, four 500 kw. units are installed.

The cross sectional area for a copper conductor may be found from the following formula:

$$\text{Circular mils} = 22 \times \frac{D \times C}{E}$$

For aluminum:

$$\text{Circular mils} = 35 \times \frac{D \times C}{E}$$

C—Current in amperes.
E—Number of volts lost.
D—Distance of transmission in feet.

Cost of Street Lighting in Kentucky.

The News of Danville, Ky., has collected data regarding the cost of street lighting in Kentucky, which show the following:

In Ashland, a city of 8,000 inhabitants, where sixty inclosed lamps are used with an all night schedule, where they burn 4,000 hours per year and coal costs 55 cents per ton, the contract price per lamp per year is $75.00.

In Frankfort, a city of 10,000 inhabitants, seventy-two open lamps are used all night and every night, and average 4,000 hours per year, coal costs $2.75 per ton, the contract price per year amounts to $96.20.

In Glasgow, a city of 4,000 inhabitants, where only twelve inclosed lamps are used, on a midnight and moonlight schedule, 1,220 hours per year, coal costs $3 per ton and the contract price per lamp per year is $116.67.

In Hopkinsville, a city of 10,000 inhabitants, where 63 open arc lamps are used all night every night, 4,000 hours yearly, where coal costs $1.25 per ton, the contract price per lamp per year is $83.33.

In Lebanon, a town of 3,500 inhabitants, where 32 open lamps are used on a moonlight schedule for 2,179 hours per year, and where coal costs $2.75 per ton, the contract price per lamp per year is $85.00.

In Mayfield, a city of 8,000 inhabitants, where thirty-two arc lamps are used on a moonlight schedule, 2,179 hours per year, and where coal costs $1.55 per ton, the contract price per lamp per year is $96.00.

At Winchester, a city of 8,000 inhabitants, where fifty-six open arc lamps are used on a moonlight schedule, 2,179 hours per year, and where coal costs $2.35 per ton, the contract price per lamp per year is $80.00.

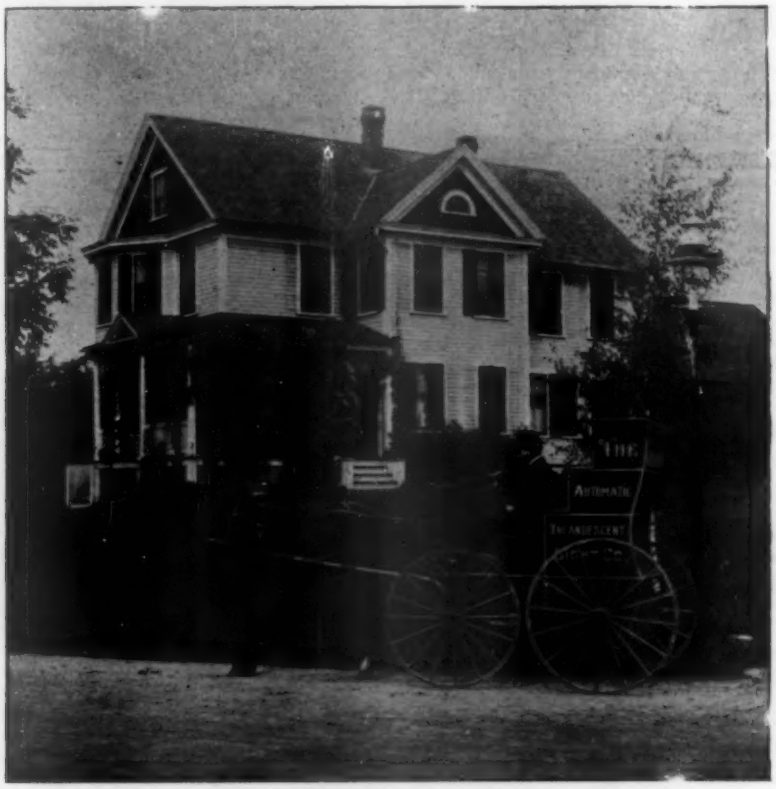
At Shelbyville, a town of 4,000 inhabitants, with thirty-one inclosed arc lamps, which run to 1 o'clock a. m. for six months and all night for six months, and where coal costs $3.00 per ton, $80.00 is the contract price per lamp per year.

Chicago Wants to Furnish Light to Its Citizens.

The city of Chicago will ask the next Legislature for authority to own and operate gas and electric lighting plants and to sell gas and electric light to its citizens, in accordance with an ordinance passed June 6 by the City Council, directing the committee on state legislation to prepare a bill providing for municipal ownership of those public utilities. The bill will authorize the city to issue certificates against the properties for the purchase or construction of gas or electric lighting plants.

Results of Municipal Ownership in Ontario.

United States Consul General Holloway, at Halifax, Nova Scotia, said in a recent report to the Department of Commerce and Labor, that many of the municipalities in Ontario own the local water works and electric lighting plants, have municipal cemeteries, and one has its own street railway. There was an average annual loss on the municipal street railway and electric lighting system combined at Port Arthur of $1,370.95 for the period of four years. Profits were shown in forty four cases and losses in forty-eight.



LIGHTING SERVICE WAGON, NORTHBOROUGH, MASS.

The Lighting System of Northborough, Mass.

Just outside of Boston, one hour and fifteen minutes' ride on the New York, New Haven & Hartford Railroad, is situated the town of Northborough. Nature has wrapped its mantle of beauty unstintingly around this beautiful suburb of Boston, and her people are proud of it. They understand and appreciate the environment and are quick to resent any interference with the adornments of nature. About one year ago the Northborough city officials discussed the question of lighting and various systems were investigated. Electric arcs were talked of, but objection was raised against these, first, on account of the unsightly wires, and the attending dangers, and secondly, the difference in cost of electricity and other systems submitted to the officials. Gravity lamps were likewise discussed, also the pressure lamps. The essential difference of these is, that in the former the fluid, whether gasoline, naphtha or kerosene, is fed by gravity from a tank located above the lamps, and in the latter it is fed by pressure.

One of the developments of the latter form was finally decided upon. That the judgment of the town officials was good,

regarding the adaptability of the lamp decided upon, which is known as the "automatic outdoor lamp," is shown by the accompanying photographs. They indicate that it well serves its purpose in lighting the streets and roads, at the same time adding to the beauties of the scenery and having no accessories which detract therefrom.

In 1891 the first United States patent was granted on a pneumatic pressure lamp. This lamp passed into the hands of persons skilled in the art of producing light and was confidently expected by them to revolutionize outdoor lighting. It failed, however, probably because the generator had to be kept hot by a subflame—which was impossible to maintain in stormy weather.

After this various evolutions took place, the result of much expert investigation and experiment and the expenditure of much time and money, resulting in the development of the automatic lamp in the form now operated under contract by the Automatic Incandescent Light Company in Northborough. A representative of Municipal Engineering Magazine visited Northborough and went carefully over the plant examining every minute detail of the actual manufacture of the various parts of the lamps in the factory and the methods of operating the lamps used in lighting the town.

The lamp consists of a circular tank placed in the dome, a vaporizing coil connected at one end to the bottom of the tank, and at the other end to the nozzle through which the gas is injected into the mixing tube. The vaporizing coil extends above the tank and has a third connection with the top of the tank through which the gas generated in excess of the amount required to operate the burner is forced into the tank. This accumulation of gas produces the pressure necessary for the operation of the lamp. The supply of oil is reduced by an automatic valve when the pressure reaches a predetermined amount, thus making it constant within very close limits and keeping the light up to a uniform intensity so long as there is oil in the lamp, and the incandescent mantle is intact.

AUTOMATIC PRESSURE LIGHT IN NORTHBOROUGH, MASS.

An examination of the form of construction of the lamp and of its method of suspension shows that there is nothing to cast a shadow on the ground within its range. As a consequence the light is uniform and clear and gives an even more effective illumination than its high candlepower would promise. Each lamp is complete in itself and, there being no attachments, it can be hung from any convenient support, whether an artistic pole, as shown in one photograph, or from the trunk of a tree, as shown in another.

There are fifty-four lights on the main thoroughfare in Northborough which are

THE AUTOMATIC PRESSURE LAMP USED AT NORTHBOROUGH.

about an ordinary street block apart. The process of lighting these lamps occupied a little over sixty minutes, fifteen to twenty seconds' use of a blow torch being necessary in lighting each lamp. The renewals for last month were one globe and three mantles, which the man in charge of the lamps stated was about the monthly average. A blow torch was used to facilitate lighting. The lights are not in the least affected by storm or wind, the protection and regulation being proof against them. Norumbega, Charles River and Oak Island Parks have recently installed the system.

The Mayor of East Orange Opposes Water Meters.

In his annual message to the council of East Orange, N. J., June 7, Mayor Bruen opposed the proposed adoption of water meters, saying that they would not prove economical. He pointed out that many municipalities have tried the proposed system, but most of them have been with unsatisfactory results. That the repairs to meters, the cost of examining them, the gradual destruction by wear and the interest upon their cost, involve an average expense of nearly, if not quite, $5 each per year; or, if their use is adopted, assuming that there are 5,000 taps in East Orange, there would be added an expense of $25,000 per year to the disbursements of the water department that would have to be met in some way. He also said that there would be likely to be a large reduction in revenue to the city and, in many cases, the consumption of water would hardly equal the cost of the maintenance of the meters.

PAVING AND PAVING MATERIALS

Detroit Asphalt Plant—A New Paving Record—General Asphalt Company Atlas Cement Analysis—National Laboratory.

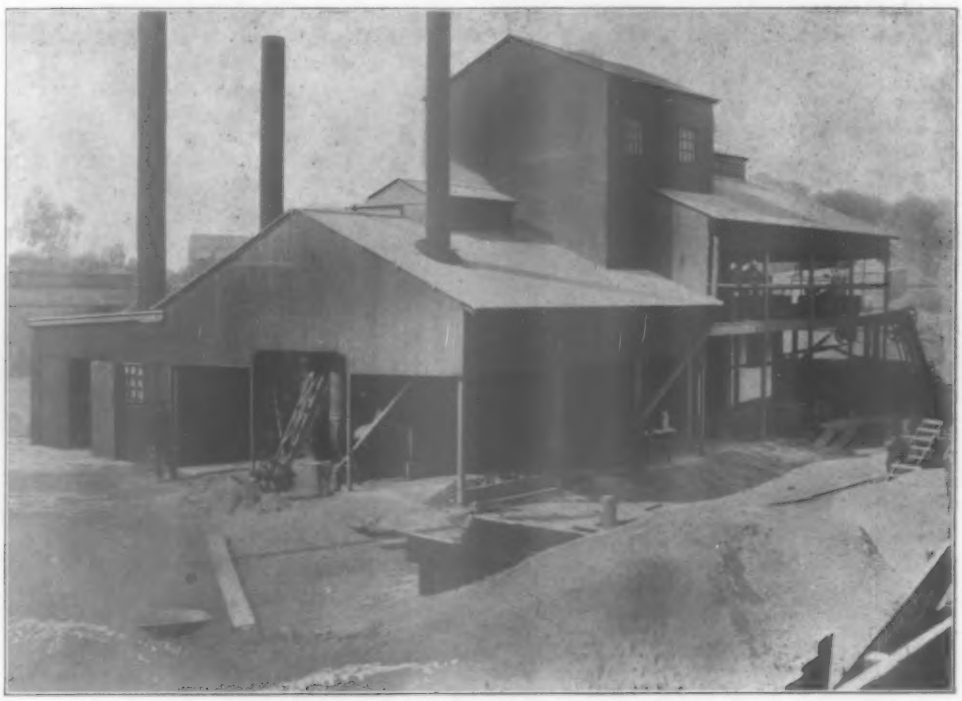
The Detroit Municipal Asphalt Paving Plant.

On Jan. 18, 1901, the city of Detroit, Mich., entered into contract with Hetherington & Berner, of Indianapolis, Ind., for the construction and installation of a municipal asphalt paving plant of one thousand yards daily capacity; it being the intention of the Public Works department to undertake work of repairing and maintaining in good condition the city's asphalt streets. Under the terms of the original contract the plant was to have been in operative condition on or before the first day of May of the same year. Not long after the closing of this contract a persistent opposition to the ideas and plans of City Engineer R. H. McCormick became evident and in various

ways the project was delayed until at one time it appeared that its consummation would be impossible. The contractors for the plant, after holding it for delivery until June, 1902, brought suit for damages in the Federal Court. While this suit was still pending, the opposition was overthrown and the matter of the municipal plant was taken up by Commissioner William H. Maybury, who succeeded Commissioner Moreland, and was rapidly pushed to completion. It was decided, however, that the plant as originally contracted for should be of larger capacity and after a conference with the designer the plans were so modified that the daily capacity was increased to 1, yards of topping two inches thick.

As far as known Detroit is the first city in the United States to own and operate its own asphalt paving plant, although some cities have made more or less serious attempts to do their own repairing. The experiment is of so much importance that its progress will be watched and reported in as much detail as possible. At this time little can be given except a description of the plant, which is now in operation, its mechanical features and the arrangements and appliances which have been made use of for the purpose of reducing cost of operation and also abating those objectionable characteristics of all asphalt paving plants, dust, odor and noise.

The illustrations accompanying this article will convey a sufficiently accurate idea of the general appearance of the plant as it stands in the city's western yards. It occupies a ground space 65 feet in length by 27 feet 6 inches in width. At one end is a side extension 18 feet wide by 28 feet long, forming the engine and boiler-room. While there is ample floor and room space for all practical purposes there is no part of it that could be dispensed with without inconvenience. The structure is made entirely of steel, with the exception of the floor covering, and is absolutely fireproof, requiring no insurance. At one end is the dryer house, containing the sand heating drums and the patent dust collectors. The opposite end of the building is called the melting shed, and in this portion are installed the large sealed kettles in which



DETROIT MUNICIPAL ASPHALT PLANT.
Sand dryer end.

the asphaltic cement is prepared. The kettles are set in masonry and about their tops is provided a platform which forms a sort of second story or floor.

Between the dryer house and the melting shed is a driveway about eleven feet in width, through which the teams drive that receive the street mixture from the mixing machines directly above. Constructed above this central driveway and extending upward to a hight greater than the rest of the building, is the tower, containing the overhead bins for the storage of hot sand, binder stone and limestone dust. Into these various bins material is delivered by link belt and bucket elevators, as will later be described.

In the engine-room is installed a return tubular boiler of seventy-five horsepower capacity. Near it is a fifty horsepower self-contained automatic engine which supplies most of the power consumed in operating the plant. In this room is also installed an air reservoir upon which is mounted an automatically governed air compressor of large capacity. A steam pump is provided for supplying the boiler with water in case of accident to the injector.

At the opposite end of the plant, in the melting shed and at the end of the kettles' masonry, is installed a second and smaller engine. This latter engine is intended especially to serve power for operating the barrel elevator and the mechanical agitators, this second engine being provided in order that melting operations, which require but a small amount of power, may be carried on without operating the main engine, the latter being only in use when the plant is turning out material for the street. It is customary to perform the operation of preparing and agitating the asphaltic cement during the night and it is one of the duties of the night man to attend to the operation of the auxiliary engine. The economy of this method will be evident.

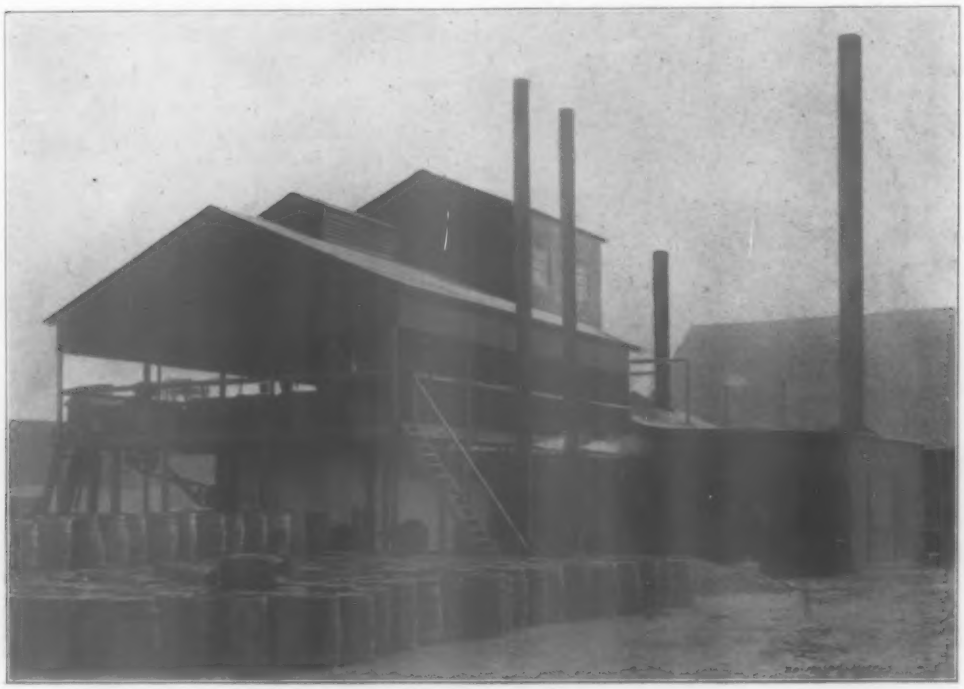
In the practice followed in the operation of this plant no open-topped melting kettles and no air agitation are used. The asphalt and its fluxing material are deposited in the closed topped combined melting kettles and mechanical agitators. After the charge is complete the heavy detachable manhole covers are lowered in place by means of chain blocks, and securely bolted down by a series of quick-acting lock bolts. The melting then proceeds until the entire mass becomes fluid, no odors or gases being allowed to escape. When the melting is accomplished, a process that occupies several hours' time, the night man starts the operation of the mechanical stirring arrangements, or agitators. This continues slowly until all of the asphaltic cement is delivered to the mixing machines and the kettle is empty. By the substitution of mechanical for air agitation a homogeneous mixture is obtained and no sediment of solid matter remains in the kettles, as is the case when the mixing or agitation is performed by compressed air. In this plant the fluid asphaltic cement is delivered to the mixers through a steam-jacketed pipe line in given quantities as required. Air pressure is the force used to expel the fluid from the sealed kettle and through the pipe line.

A sufficient time before actual operations begin in the morning the firemen start fires under the sand drums, which are slowly revolving cylinders of considerable size and constructed of steel plates. When the drums are heated to proper condition, operators called feeders begin shoveling sand into the elevator which carries it up and dumps it into a chute leading into the interior of the drums. It then passes through the whole length of the interior of the drums and is delivered into a chain and bucket elevator which carries it up vertically a distance of thirty feet and discharges it into a steel plate receptacle called the hot sand bin. This hot sand bin has capacity to contain about twenty-five tons of hot sand. In the upper part of the bin is located a rotary screen, and before falling to rest in the bin the sand first passes through the screen, the offal or screenings passing out at the end and through a conducting pipe to the ground. The chute which conducts the hot sand from the head of the elevator into the screen is so designed and constructed that at any time should the bin be full or the sand not of proper temperature, the movement of a lever will deflect its course and instead of entering the screen and bin it will pass back to the sand pile in the yard, from whence it came.

Alongside of the hot sand bin stands another steel plate bin called the binder bin. This binder bin receives and stores the heated broken stone that is used in making binder. The binder stone is heated in the same drying drums that heat the sand, and the same elevator carries it up to the same chute that leads the sand into the screen. It does not

enter the screen, however, but, by the movement of still another lever its course is switched to the binder bin into which it is discharged. On the opposite side of the hot sand bin is a place for still another steel bin; this latter is called the limestone dust bin. The pulverized limestone, which enters into the composition of the street mixture, is carried up to and deposited in this latter bin by a belt and bucket elevator. Thus all of the ingredients required for the street mixture, excepting the asphaltic cement, are stored overhead in positions from which they may be readily drawn as required. The limestone dust bin is provided with steam heating coils by means of which that material is kept dry and warm.

The plant is provided with two mixing machines of the usual type, one for mixing binder and one for topping mixtures. The topping mixer is situated directly beneath the center of the hot sand bin and the binder mixer beneath the binder bin. Attached to the bottoms of the hot sand bin and the binder bin are automatic measuring boxes which will contain eight cubic feet each. From the bins the material, sand or broken stone, is dropped into these measuring boxes by operating a lever. The operation of another lever discharges the contents into the mixer. The limestone dust is discharged into the mixer in a somewhat similar manner. While these operations are being performed the asphalt measuring bucket is being filled with the melted asphalt from the pneumatic delivery pipes connected with the kettles. When filled the asphalt bucket is run along its trolley rail to the mixer and its contents are poured into the other material already in the mixer. After mixing a proper length of time the operator pulls a lever and the whole mass is dropped from the mixer to the wagon which stands below. These operations continue successively. In this plant it has been the endeavor of the builder to reduce to a minimum the annoyance of flying limestone and sand dust, a disagreeable feature of all ordinary asphalt paving plants. The mixing machines are connected with the sand, binder and limestone bins in such manner that the light dust cannot escape to the outer air. The sand heating drums, which are also generally fruitful sources of sand distribution, are provided with an apparatus of



DETROIT MUNICIPAL ASPHALT PLANT.
Asphalt Kettle end.

recent invention, into which the products of combustion, containing smoke and fine sand, are discharged before being allowed access to the air through the smoke-stacks. By an application of the laws of gravity in connection with centrifugal force, combined with the exhaust steam from the engines, the sand and heavier portions of the products of combustion are extracted and held, while the lighter smoke and hot air are allowed to escape. There are many minor conveniences in connection with this plant, including a barrel elevator, all of wnich are designed to obtain the greatest economy of labor and cleanliness of operation.

The novel features of the plant, such as the sand chute, the overhead storage, the dust catchers, etc., were invented and patented by F. A. Hetherington of Indianapolis.

The plant has been in operation during June under the management of Clarence A. Proctor, inspector, making repairs. The city's rollers were not put in operation until late in the month. Notwithstanding the lack of machinery and the troubles of starting the plant, the gangs of men put down about 4,500 square yards of patching between June 7 and June 21 without a hitch of any kind in the plant. It is expected to run steadily during the season with one patching and one resurfacing gang. Mr. Proctor, who was recommended to his position by Mr. A. W. Dow, inspector of asphalts and cements for the Engineer Department of the District of Columbia, thinks that he can lay asphalt under the existing conditions at a much lower figure than the city has paid under contracts in the past. The plant is in full working order and the force is now quite well organized and some interesting figures will doubtless be forthcoming later in the season.

LINDELL BOULEVARD, ST. LOUIS, MO., BEFORE SPREADING FOUNDATION STONE.

A New Paving Record.

The Granite Bituminous Paving Company of St. Louis, Mo., has just established a paving record that is likely to stand for some time. This company on June 1 finished laying in Lindell boulevard 60,000 square yards of Warren's bitulithic paving in forty-five days, ten days of which were stormy and work had to be suspended.

Lindell boulevard is a very handsome thoroughfare and is one of the principal avenues leading to the grounds of the Louisiana Purchase Exposition. On account of the delay of the City Council of St. Louis in passing the appropriation for the paving of Lindell boulevard, Street Commissioner Varrelmann was doubtful about recommending the awarding of the

contract. He insisted, however, before the contract was let that the contractors must agree to complete the work by June 1 so as to have the street open to travel for the World's Fair.

The paving company accepted the conditions and prepared to meet them. Its three large paving plants were put in complete working order, and a gang of one thousand men was organized. In a few days the men were like automatic parts of one huge piece of machinery so smoothly and rapidly did the work progress. The inspectors who had charge of the supervision of the work closely watched every detail.

Rain interfered with the work for ten days, but this only served to spur the contractors to renewed efforts and the plants were pushed to their capacity. As soon as the foundation stone was laid and rolled the gang of sprinklers coated the coarser stones with bitumen, preparatory to the laying of the bitulithic surface. Hardly had this been completed when a steady procession of teams laden with the heated mixture which forms the wearing surface were wending their way from the mixing plants to the streets.

The organization was perfect; each man knew his place and with clocklike regularity the work proceeded, some days as many as 3,500 sq. yds. of pavement being laid. When nearing completion the work was ahead of the schedule that the contrators had mapped out for themselves and promptly on time the contract was completed to the satisfaction of the inspectors and contractors and to the delight of Street Commissioner Varrelmann, who characterized it as the finest and fastest street paving ever accomplished. The contractors say their performance will stand for a long time as a record and they call attention to the fact that they had ten days when they could not work on account of the weather.

Lindell Boulevard is lined on either side with beautiful residences, surrounded with well-kept velvety lawns, and is the

LINDELL BOULEVARD, ST. LOUIS, MO., AFTER SCREENINGS WERE SPREAD ON FINISHED SURFACE.

"show" street of the exposition city. The property owners have always taken a pardonable pride in its appearance and it was largely in response to their petition that Warren's bitulithic pavement was selected for it.

Two years ago, after considerable opposition Warren's bitulithic pavebent was introduced in St. Louis and since that

WEST PINE BOULEVARD, ST. LOUIS, MO., LAID MAY, 1903. TRAFFIC 3,100 VEHICLES A DAY—HEAVY LOADS.

date about nine miles of this pavement have been laid. It has been placed on the finest as well as some of the most heavily traveled streets in St. Louis and has received high praise from all interested classes of traffic.

The pavement has been laid in seventy-five cities in the United States and Canada. The first pavements laid in Eastern cities, upon which nothing has been spent for repairs, are even better today than when first laid and the predictions of engineers regarding its success have been fulfilled.

The Organization of the General Asphalt Company.

The following from the annual report of the General Asphalt Company describes the organization of its subsidiary companies:

The General Asphalt Company was incorporated May 19, 1903, and thereafter promptly proceeded to reorganize and consolidate the business and accounts of the companies and properties which it acquired.

At that time the business was divided among sixty-nine different corporations, fifty-four of which were wholly owned by the General Asphalt Company. The

business of these fifty-four companies has been consolidated substantially into four active companies, namely: The Barber Asphalt Paving Company, the New York Trinidad Lake Asphalt Company, limited; New York and Bermudez company, South American Asphalt Paving Company.

The Barber Asphalt Paving Company is the chief operating company, and is engaged in the refining, manufacture and sale of asphalt and asphaltic products, and in the construction of pavements. The New Trinidad Lake Asphalt Company, Limited, and the New York and Bermudez Company are supply companies, only, and engaged in the sale of asphalt from deposits owned or controlled by them. The South American Asphalt Paving Company is engaged in paving in South American cities.

Of the fifty-four companies wholly owned by the General Asphalt Company at the time of its organization, the business of the many paving companies had previously been absorbed into the Barber Asphalt Paving Company by certain forms of lease. Further progress has since been made toward simplification of operations and accounting, in that twenty-two of said companies are being dissolved and their assets and business completely merged into the Barber Asphalt Paving Company. Others have been and are being taken over and will be dissolved as rapidly as their affairs can be arranged to permit dissolution.

Of the fourteen partly owned companies, one is in process of liquidation; two have been dissolved by mutual consent; the outstanding interest in another has been acquired and the company dissolved; in a fourth the minority interest is about to be sold; in two others the capital stock has been reduced by mutual consent, and a partial distribution of the assets has been made with a view to ultimate liquidation; and in three our interest has been abandoned as of no value.

The consolidation of all active business, assets and accounts in the Barber Company, other than those of the two supply companies, The New Trinidad Lake Asphalt Company, Limited, and the New York and Bermudez Company, and the South American Asphalt Paving Company, has resulted in a concentration of control, a simplification of accounting and a reduction in cost of operating.

Th Barber Asphalt Paving Company—All of the plants and real estate of this company, including those of the various companies consolidated with it during the last year, were carefully re-appraised during the year. Real estate, hitherto standing on the books of the company at $1,347,794.90, was written down to $1,310,-288.32; and plants appraised at $2,563,077.33 were written down to $1,784,088.67; resulting in a total depreciation of property account of $816,495.24. This special depreciation was made as of July 1st, 1903, in addition to which the sum of $158,207.36, being for purpose of annual depreciation, was written off from plant account as of January 31st, 1904. The balance sheet of The Barber Company contains only two items of inter-company accounts, namely, one with The New Trinidad Lake Asphalt Company, Limited, and the other with the New York and Bermudez Company.

The erection of the principal refinery of The Barber Asphalt Paving Company on nineteen acres of land belonging to the company, with water front at Maurer, N. J., has been completed. The plant is extensive and modern and possesses ample capacity for refining asphalt for paving purposes, and also for the manufacture of other asphaltic products, such as roofing felts, ready-made roofings, mastic paints, pipe dip and other articles of commerce composed wholly or in part of asphalt, for which the company is now seeking to establish a market.

The New Trinidad Lake Asphalt Company, Limited—This company owns the concession to the Pitch Lake in the Island of Trinidad and also has large interests in the land asphalt deposits outside of and surrounding the lake.

During the year 1903 there were extracted 181,076 tons of crude asphalt from Trinidad Pitch Lake, of which 129,392 tons were carried to the United States and 34,834 tons to Europe. This total tonnage shows an increase over 1902 of 37,324 tons; over 1901 of 44,552 tons; over 1900 of 57,863 tons.

The digging and sale of land asphalt has considerably diminisned because of the depletion or exhaustion of the several irregular deposits of land asphalt that had been found and worked within the areas of the several town lots in the village of La Brea, owned or controlled by competitors.

New York and Bermudez Company—The exclusive right of all asphalt in the former State of Bermudez, Venezuela, was obtained by this company through the acquisition of a concession from the government of Venezuela granted in 1883.

Subsequently, mining titles and real estate titles were acquired to Bermudez Lake, the only asphalt deposit of importance in that territory. Thereafter the company remained in undisturbed possession until December, 1900, when an effort was made by competitors to annul the concession and secure title to the property for their own use and benefit. The protracted litigation growing out of this effort to take away the company's property continued with great activity and at heavy expense until February, 1904, when a decision was unanimously rendered by the High Federal Court, the court of last resort in Venezuela affirming the company's title and calling upon the executive departments of the Republic of Venezuela to cancel and set aside all other mining claims within the former State of Bermudez.

The total number of tons extracted from Bermudez Lake during 1903 was 23,264, of which 22,357 was shipped as crude and 907 was refined at the Lake. This total was 14,845 tons in excess of the shipments of 1902, and 1,075 tons in excess of the shipments of 1901. The shipments of 1902 were much curtailed because of the then existing revolution in Venezuela. All of the shipments of 1903 were to the United States.

South American Asphalt Paving Company—This company wos organized to take over the business of a partly owned company which had done business in Buenos Ayres, Argentine, for a number of years. The company secured no new contracts during the year 1903, and it therefore shows a loss for the year. Since the close of the year 1903 it has obtained contracts in Rio Janeiro, Brazil, and Santiago, Chili.

Chemical Analysis of Atlas Portland Cement.

The following are the results of analysis of Atlas Portland cement, made by the Atlas Portland Cement Company of New York city, as reported by Dr. Charles F. McKenna, chemist, of New York city. Dr. McKenna's competence as a cement chemist insures that the analysis is correct. The following are the percentages of the various constituents of the cement:

Silica	21.30
Alumina	7.65
Iron sesquioxid	2.85
Lime	60.95
Magnesia	2.95
Sulphuric acid, anhydrous	1.81
Carbonic acid	1.14
Potash	0.517
Soda	0.631
Moisture	0 970
Total	100.068

National Road Material Laboratory.

The Secretary of Agriculture of the United States has established in the bureau of chemistry of his department a division of tests, the work of which is to be the testing and investigation of road materials and all materials of construction relating to agriculture, and to do collaborative work provided by law with other departments.

MUNICIPAL AND TECHNICAL LITERATURE

Municipal Reports—New Publications.

Municipal Reports.

Eighth Annual Report of the Board of Public Works, Poughkeepsie, N. Y., 1903. Charles E. Fowler, Superintendent and Engineer.

Mr. Fowler has been in charge of the waterworks and other public works for many years, and evidently gives very satisfactory service. Water and sewers are run in the same accounts but it seems to be the intention to make the sewer assessments and appropriations equal to the expenditures for maintenance and construction. The total receipts of $52,691 and expenditures of $48,773 thus show a profit on waterworks

maintenance of $3,900, to which may be added $3,075 expended on extensions. Highways cost $17,000, practically all for maintenance. Streets are swept by hand. Each man swept practically a half mile length of street, working eight hours a day, the entire area of 66,981 square yards of smooth paved streets, 3.38 miles in length, being swept once each week day.

Ninth Annual Report of the Board of Public Works and Water Commissioners of Little Falls, N. Y. 1903. E. T. Lansing, City Engineer.

The report of the board is taken up mainly with detailed reports of expenditures on various accounts which, with a few exceptions are not collected and classified, so that it would be a difficult matter to make comparisons of accounts of various years or with other cities. The reports say that 1,234 feet of brick paving were laid, but on what specifications or at what cost it is not possible to ascertain.

The water-works receipts, from the treasurer's report, seem to have been about $35,529, and the expenditures $28,585, showing a profit of about $7,000, although $9,206 of the expenditures were for bonds paid. The system is a gravity system and the largest item of expenditure aside from the above and $9,284 for land damages and riparian rights is $3,946 for salaries and expenses in the water-works office.

Eleventh Report of the Water Department of the Town of Attleborough, Mass., 1903. G. H. Snell, Supt.

The summary of statistics in this report is on the standard form. It shows an estimated population of 13,000 in the town, 12,500 on the water pipe lines, and an average consumption per day of thirty-three gallons for each inhabitant and thirty-seven gallons for each consumer.

The water is pumped from a well into a standpipe 125 feet high. Maintenance, including $4,666 pumping expense and $13,845 interest, cost $27,894. The receipts from rents, etc., were $29,087. The town made an appropriation of $4,000 for public purposes and the water department turned $5,200 into the sinking fund.

The bonded indebtedness was increased $30,000 during the year, practically all being expended for new construction. The cost of the works has been $451,853, and the net indebtedness, sinking fund allowed for, is $300,000. The income of the department has almost doubled in the past six years, so that the town has been able to take care of the considerable increase in indebtedness on account of large extensions and at the same time reduce the appropriations made from the town treasury nearly half. Counting hydrants at $30 and the other water used for public service the town should pay over $12,000 a year toward the support of the water works, and actually paid last year one-third this amount. This seems to be an example of successful municipal ownership.

Report of Battle Creek (Mich.) Water-Works for 1903. W. W. Brigden, Superintendent.

Battle Creek uses the meter system, and has now 87 per cent of its taps metered. It is able thus to keep the consumption per inhabitant down to 51 gallons a day, on an estimated population of 25,000. The percentage of water metered is 58½, showing the amount used or wasted for public purposes. A table shows the amount estimated by the superintendent for each public and private purpose, and the value of the water, which varies from $230 a year for flushing sewers and blowing off hydrants to $3,300 for parks and public buildings, with $2,300 additional for schools. The loss by leaks is estimated at $3,000. The percentage of the whole consumption paid for is 64½, leaks account for 6½ per cent and the remaining 29 per cent is for the public uses referred to.

Annual Financial Statement of the City of Shreveport, La. C. G. Rives, Comptroller.

This little pamphlet gives the items of receipts and expenditures of the various funds of the city. They are not summarized nor is there any clear statement of the appropriations and assessments, so that it is difficult to make comparisons or to find the exact standing of any fund without making an individual account of it and collecting its items from the various pages on which they appear. The average taxpayer finds it difficult to understand an account when it is put in the simplest possible form and is very likely to imagine that matters are in bad shape when deficits are reported and he cannot find out readily the reasons for them.

The city's total receipts were $267,550.77 and expenditures $272,553.55, leaving an apparent deficit of $5,002.78, but funds yet to be collected much more than balance this discrepancy. Each bond issue has its own provision for sinking fund, so that the $397,000 indebtedness of the city now has a fund of $52,834.57 from which to pay interest and principal, and all will be paid in about 12 years.

New Publications.

The Mechanical Engineer's Reference Book, a handbook of tables, formulas and methods, by Henry Harrison Suplee, B. Sc., M. E. 834 pp.cloth thumb-indexed, $5.50 net; without thumb-index $5 net. J. B Lippincott Co., Philadelphia, Pa.

In his preface Mr. Suplee states that he has confined this book principally to the presentation of tables, formulas and reference data for designers of machinery, so as to render it useful in the drawing room both for general principles and for detailed methods. It is quite impossible to make a book of this sort which will answer all the needs of every one ,but the author has succeeded in making a book which is a material improvement over Nystrom's pocketbook, to which it is intended by the publishers to be a successor.

The mathematical tables and formulae cover 233 pages and include the usual multiplication and factor tables, roots and powers, conversation tables, 5-place logarithms of numbers and trigonometric functions, areas and volumes, etc. The formulae of mechanics are most fully given in the sections useful for machinery design. They occupy about 50 pages. Materials of engineering occupy 65 pages with tables of weights, specific gravities, dimensions of pipes, tubes, chains, glass, fittings, valves, rope, etc., etc. The subject of strength of materials is treated with as much fullness as 70 pages will permit, including the elements of a few standard sections of steel and safe loads for columns, properties of springs, specifications for steel and wood and tables of ultimate strength of many materials. But a failure to state the proportions of concrete makes the figures regarding mortar and concrete too indefinite to be of much value.

Machine design takes 70 pages, and seems to have the best selected information of any part of the book.

Heat, 22 pages; air, 15 pages; water, 53 pages; fuel, 10 pages; steam, 10 pages, are sections containing the usual data which are carried forward from book to book often without much consideration of the improvements which might be made.

The sections on steam boilers, steam engines and internal combustion motors, in addition to the data regarding design give full instructions for conducting tests of boilers, steam and gas engines.

The division devoted to electric power, 70 pages, is mainly occupied by the National Electrical Code and the report of the committee of the American Institute of Electrical Engineers on standardization.

The cost of water, steam, gas and electric power is well shown in nine pages. Eight pages are devoted to the principles which should govern the management of works.

The book is certainly a very valuable collection of data in convenient shape for consultation. The index, however, is not very satisfactory either in arrangement or in completeness. The writer has not been able to test the accuracy of the proofreading of the book. First editions are liable to contain typographical errors and users of a new book must be on the lookout for them.

Second Annual Report of the Civic Improvement League, St. Louis, Mo. Earle Layman, Secretary.

St. Louis has many public spirited citizens who have made a very valuable society of the Civic Improvement League. Its committees cover all lines of municipal betterment. Play grounds, free baths, historic tablets, sanitation, vacant lots, statuary, pure milk, signs, smoke abatement, tenement, water purification, tree planting, waste paper box are the names of a few of them, taken from the list. This little report is of value not only to the members of the league, but to many in other cities as an indication of what large results can often be obtained by organized effort, and how promptly they begin to show.

Contributions to Economic Geology, 1903. U. S. Geological Survey, S. F. Emmons and C. W. Hayes, Geologists in Charge, Washington, D. C.

These contributions are in the form of papers upon the occurrence of minerals in various districts. Perhaps the most interesting to our readers will be those on cements in Alabama, the Lehigh district and Virginia, and on rock gypsum in Utah. The study of Alabama cement materials is quite full and touches upon most of the localities in which cement materials can be found in commercial quantiites. That of the Lehigh district gives a short statement of the geology of the district and descriptions of the methods of combining the materials. The short sketch of the cement possibilities in Virginia defines in a general way the districts in which cement manufacture would be likely to become profitable.

ORGANIZATIONS AND INDIVIDUALS

International Engineering Congress—Water Works Association—Society of Testing Materials—Technical Meetings—Personal Notes.

International Engineering Congress.

Circular No. 3, issued by Charles Warren Hunt, secretary of the committee in charge of the International Engineering Congress, to be held in St. Louis, Oct. 3 to 8, gives a list of thirty-eight subjects and of one hundred engineers selected by the committee to discuss them. The list includes engineers of national reputation in the respective fields which they are chosen to represent, in each of the principal countries of the world. The proceedings of the congress will easily reach the eminence of being the most valuable collection of engineering papers ever made. The expenses of the congress and of publishing the proceedings will be so great that it has been decided to increase the membership fee to $10, including a copy of the proceedings.

Convention of American Water Works Association.

The twenty-fourth annual convention of the American Water Works Association was held in St. Louis, Mo., June 6-9, inclusive. In the absence of President L. N. Case, who was ill at his home in Duluth, Minn., his annual address was read by Morris R. Sherrerd, first vice-president, of Newark, N. J. Officers were elected as follows: President, M. R. Sherrerd, Newark, N. J.; vice-presidents—B. C. Adkins, St. Louis, Mo.; F. H. Bennett, Oswego, N. Y.; C. E. Rowe, Dayton, O.; D. H. Maury, Peoria, Ill.; A. A. Tucker, Memphis, Tenn.; secretary-treasurer, J. M. Diven, Elmira, N. Y.; finance committee—H. E. Keeler, Chicago, Ill.; A. Milne, St. Catherine, Ont.; R. J. Thomas, Lowell, Mass. The association decided upon West Baden, Indiana, as the next meeting place.

William R. Hill of New York City read a paper on "The Modification of the Plans of the New Croton Dam." In his paper on "Experience With Growth in Water Mains," Owen T. Smith of Freeport, Ill., said that in 1895 the water supply of Freeport suddenly acquired a bad taste and odor, which could not be accounted for in the ordinary way, the supply being from wells along the drift in the river bottom. The mains were flushed and the suction pipe cleaned by a large flue brush, made to order, and all that could be thought of was done to get rid of the trouble. Finally, a sample of water was taken, which had a yellowish brown matter floating in it. It proved to be crenothrix kuhniana, or well thread. A systematic study of the growth and the means of getting rid of it developed the fact that the growth depended upon the iron in solution in the water, and that it required about 0.30 parts per million of the iron in order to feed the growth. It was finally decided that the only adequate means of eliminating the growth was the construction of a filter plant to remove the iron and carbonic acid gas. The New York Continental Jewell Filtration Company erected a small experimental plant at the works, and in the various made during these experiments the amount of iron varied from 19 parts per analyses of the raw water which were million in the outskirts of the system to much lower at the pumping station and in the city. All carbonic acid was removed in the filtered water. Lime water was used as a coagulant, 2 to 4 grains of lime per gallon, with the result that the iron was reduced to an average of about 0.04 part per million, while carbonic acid was removed and the water softened 13 to 15 per cent. and this average has been continuously maintained up to date.

In a paper on "The Cost of Cast Iron Pipe," John W. Alvord of Chicago presented a diagram showing the actual contracts made since 1883 for cast iron pipe in the States of the Central West centering about Chicago

A paper on "Meters, Their Use and Benefits," was presented by Park Woodward, general manager of water-works at Atlanta, Ga., who said that prior to 1885 there were no meters in Atlanta. The rate charged for water was regulated by the number of outlets used by the con-

sumers. The consumption of water became so great that additional pumping machinery became a necessity in order to supply the demand and give necessary fire pressure. Finally water meters were installed, which saved money for the general taxpayers of the city, for, without their use the rate of taxation would have been increased in order to raise the sufficient money to pay for an additional main, more pumping machinery, larger reservoir, and other necessary additions to the plant, estimated at that time to cost approximately $150,000 or more.

In a paper on "The Meter System in Cleveland," Edward W. Bemis, superintendent of water works, said, "No city ever set so many meters in so short a time as has Cleveland during the last two years. The number in use increased 21,686 during 1902 and 1903, 96 per cent of which increase was 5-8-inch meters. There were only 121 of them in use during December, 1901, but in December, 1903, there were 20,850.

Alfred M. Quick, water engineer at Baltimore, Md., read a paper on "Water Service at the Baltimore Fire," in which he said:

"After carefully considering the matter and attempting to collect information in preparation for such a paper, I find that while most valuable lessons are to be learned from the fire in relations to the comparative merits of different styles of building construction of various building materials, and of various appliances for fire protection in buildings, I am somewhat doubtful as to whether much of any value is to be learned in relation to the water service.

However, there are three points that occur to me, the experiences of this fire in regard to which might suggest something valuable, or at least interesting, to water-works officials.

1. As to the adequacy of any water service to successfully cope with such an emergency.

2. As to the effectiveness of private fire service fixtures in protecting property.

3. As to the possibility of the waste from broken water pipes in buildings destroyed by fire temporarily crippling the water service.

After a description of the water-works system, the distribution system in the fire district, the origin and cause of the fire, the water service during the fire, etc., he makes the following summary:

1. There are some fires which no water supply system, no matter how adequate it may be, will put out.

2. Private fire service can do very effective work in protecting property and their installation should therefore be encouraged within reasonable limits.

3. Every water supply system should have a liberal excess of storage, pumping, or delivering capacity over the demands for ordinary domestic consumption to prevent the very large increase in draught for fire service and waste from crippling the service in such emergencies.

Other papers submitted were: "Meter Rates," John B. Heim, superintendent water-works, Madison, Wis.; "The Equity of a Minimum Charge for Metered Services," Frank C. Kimball; "Private Fire Systems," L. N. Case, manager water and light department, Duluth, Minn.; "Resistance Due to Bends in Pipes—Application of Existing Formulas to a Given Case," John C. Trautwine, jr., Philadelphia.

The joint committee on the Union Engineering Building in New York City invited the association to take a share in the accommodations of the new building, but it declined, saying that the association has no permanent funds and no library, and only rarely holds its meetings in New York City

Society for Testing Materials.

The annual meeting of the American Society for Testing Materials was held in Atlantic City, N. J., June 17 and 18. Officers for the ensuing year were elected as follows: President, Dr. Charles B. Dudley, Altoona, Pa.; vice-president, R. W. Lesley, American Cement Company, Philadelphia; secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia; member executive committee, James Christie, American Bridge Company, Wissahickon, Pa.

Of the eleven special committees that have been at work the last year preparing specifications, six submitted reports and a number of new specifications were received, to be submitted to letter ballot of the society. A number of papers were read during the meeting, which not only related to the subjects of the reports, but covered more ground than the reports, which dealt chiefly with specifications. Among these papers were the following: "Alloy Steels," William Metcalf, Pittsburg; "Some Possible By-Products in the Portland Cement Industry" Clifford Richardson, Long Island City, N. Y.; "Tensile Impact Tests of Steel," Prof. W. K. Hatt, Lafayette, Ind.; "Staybolt Iron and a Machine for Making Vibratory Tests," H. V. Wille; "A. New Chuck for Holding Short Test Pieces," T. D.

Lynch, East Pittsburg; "Bending Movements in Rails," P. H. Dudley. Reports giving tests were submitted by the committees on the following: Tests for preservative coatings for iron and steel; specifications for cast iron and finished castings; specifications for natural and Portland cements; tests of concrete-steel beams; specifications for iron and steel.

The committee for the ensuing year on standard specifications for cement is composed of the following members:

Chairman George F. Swain, Professor of Civil Engineering, Mass. Inst. of Technology, Boston, Mass.

Vice-Chairman, George S. Webster, Chief Engineer, Bureau of Surveys, Department of Public Works, Philadelphia.

Secretary, Richard L. Humphrey, Consulting Engineer and Chemist, Harrison Building, Philadelphia, Pa.

Booth, Garrett & Blair, Engineers and Chemists, 406 Locust-st., Philadelphia, Pa.

T. J. Brady, President, Coplay Cement Manufacturing Co., Coplay, Pa.

C. W. Boynton, Inspector of Cements, Baltimore & Ohio Railroad Company, Wheeling, W. Va.

Spencer Cosby, Major, Corps of Engineers, U. S. A., War Department, Washington, D. C.

Allan W. Dow, Inspector of Asphalt and Cements, District of Columbia, Washington, D. C.

L. Henry Dumary, President, Helderberg Cement Company, Albany, N. Y.

A. F. Gerstell, General Manager, Alpha Portland Cement Company, Easton, Pa.

Edward M. Hagar, Manager, Cement Department, Illinois Steel Company, Chicago, Ill.

Wm. H. Harding, President, Bonneville Portland Cement, Land Title Bldg., Philadelphia.

Lathbury & Spackman, Engineers and Chemists, 1619 Filbert-st., Philadelphia.

Robert W. Lesley, President, American Cement Company, 22 S. Fifteenth-st., Philadelphia.

F. H. Lewis, Manager, Virginia Portland Cement Company, Fordwick, Va.

John B. Lober, President, Vulcanite Portland Cement, Land Title Bldg., Philadelphia.

Andreas Lundteigen, Asst Manager, Peerless Portland Cement Company, Union City, Mich.

W. W. Maclay, President, Glens Falls Portland Cement Company, Glens Falls, N. Y.

Charles A. Matcham, Manager, Lehigh Portland Cement Company, Allentown, Pa.

Charles F. McKenna, Consulting Chemist, Laboratories, 221 Pearl-st., New York.

Spencer B. Newberry, Manager, Sandusky Portland Cement Company, Sandusky, O.

F. H. Bainbridge, Asst. Engineer of Bridges, Illinois Central Railroad Company, Chicago, Ill.

J. Madison Porter, Professor of Civil Engineering, Lafayette College, Easton, Pa.

Joseph T. Richard, Chief Engineer Maintenance of Way, Pennsylvania Railroad Company, Broad-st. Sta., Philadelphia.

Clifford Richardson, Director, New York Testing Laboratory, Long Island City, N. Y.

Louis C. Sabin, Asst. Engineer, United States Engineer Office, Detroit, Mich.

Harry J. Seamon, Superintendent, Atlas Cement Company, Northampton, Pa.

S. S. Voorhees, Engineer of Tests, Supervising Architect's Office, Treasury Department, Washington, D. C.

Olaf Hoff, Engineer of Structures, New York Central & Hudson River Railroad, Grand Union Sta., New York.

W. S. Eames, President American Institute of Architects, St. Louis, Mo.

W. J. Kelly, Vice-President American Railway Engineering and Maintenance of Ways Association, Minneapolis, Minn.

Technical Meetings.

The eighth annual meeting of the League of American Municipalities will be held in East St. Louis, Ill., October 4, 5 and 6. The program, which is quite varied, will embrace subjects relating to municipal charter, garbage disposal, street lighting, sewage disposal, filtration of water, street paving and many phases of municipal work and questions.

The National Municipal League and the American League for Civic Improvement postponed the meeting to be held at the St. Louis Exposition the week begining June 13 until in the autumn, when they will be held in conjunction with the meeting of the Mayors of the different cities of the country.

The annual convention of the Central States Water-Works Association will be held in Toledo, O., August 16.

Personal Notes.

F. T. Rolf has been reappointed City Engineer at Streator, Ill.

L. A. Amsden has been appointed city engineer at Ashtabula, O.

Prof. W. F. M. Goss, M. Am. Soc. M. E., dean of the Schools of Engineering of Purdue University, Lafayette, Ind., has

received the honorary degree of Doctor of Engineering from the University of Illinois.

R. L. McNally has been elected Mayor of Union, S. C., to succeed the Hon. Macbeth Young.

G. H. Swan has been reappointed superintendent of water works at Niagara Falls, N. Y.

Charles W. Scott has been reappointed superintendent of public works at Uxbridge, Mass.

A. A. Knudson of New York City, is conducting an electrolysis investigation at Altoona, Pa.

Dr. J. H. Hudson, Mayor of Negaunee, Mich., was found drowned in the Escanaba River June 6.

Stephen A. Mitchell has been appointed chief engineer of the city water works at Kansas City, Mo.

P. A. Courtwright, a former City Engineer of Marshall, Mich., has been elected City Engineeer of Ypsilanti.

Cornell B. Adams has been appointed Assistant Civil Engineer to the Sewerage and Water Board at New Orleans.

David Morey has been appointed superintendent of water works at Troy, N. Y., to succeed Thomas H. McDonough.

Dwight H. Parsons has been appointed superintendent of water works to succeed Herbert T. Snow, at Westfield, Mass.

D. W. Mead of Chicago has been elected to the chair of hydraulic and sanitary engineering at the University of Wisconsin.

Anton Anderson has been appointed engineer at Lafayette, Ind., succeeding G. H. Stevenson, whose term expires in September.

George W. Batchelder has been reappointed water commissioner at Worcester, Mass., to succeed the late John G. Brady.

Frederick Schafer has been appointed superintendent of water works, succeeding George Schock, resigned, at South Bend, Ind.

W. G. Williams has resigned as superintendent of the light and water plant at Hibbing, Minn., and will be succeeded by O. Fiscus.

E. Clay Himanus, president of the first branch of city council, succeeded the Hon. Robert M. McLane as Mayor at Baltimore May 31.

John W. Fulwider has been re-elected city engineer at Lebanon, Ind., and A. C. Hoover has been re-elected superintendent of water works.

Moses Stoppard has been elected Water Commissioner for a term of five years at Binghamton, N. Y. Mr. Stoppard has held this position for the last ten years.

Walter T. Avery, who in early life was a civil engineer and was connected with the building of the original Croton water works, died at East Moriches, L. I., June 10.

Mr. Frederick John Warren of Warren Brothers Company, Boston, Mass., was married June 15 to Mrs. Margaret Slenker Warren, daughter of Mrs. James Geddes Slenker of Morristown, N. J.

F. L. Seages, who has been in the artificial stone business for a number of years, has accepted a position as superintendent of the American Stone and Construction Company, Ltd., at Battle Creek, Mich.

C. C. Larkin of Chicago, Ill., superintendent of construction of the Mead artesian water supply system at Ft. Worth, Tex., has been offered the position of superintendent of water works of that city, to succeed the late Capt. A. W. Scoble.

B. B. Lathbury has retired from Lathbury & Spackman, Inc., 1619 Filbert-st., Philadelphia, and the business of the company will be carried on under the name of the Henry S. Spackman Engineering Company, by Henry S. Spackman and the old staff.

T. F. Manville, president of the H. W. Johns-Manville Co., New York City, E. B. Hatch, president Johns-Pratt Co., Hartford, Conn., and J. W. Perry, manager of the electrical department of the former company, sailed for England April 26, expecting to return about June 10.

The Hon. Robert M. McLane, Mayor of Baltimore, Md., committed suicide May 30 by shooting himself in the head. Mayor McLane's act is believed to have been caused by temporary aberration of mind brought on by constant and difficult work in the administration of the city's affairs since the fire in February.

Guy Miltimore, Assistant City Engineer at Chicago, Ill., was killed by an explosion in the sewer in Thirty-ninth-st., June 11, which he and four other men were entering. An accumulation of sewer gas caused the explosion, in addition to which it is believed that petroleum had leaked into the sewer, for a fierce fire burned for fifteen minutes after the explosion.

Allen Hazen, M. Am. Soc. C. E., has formed a partnership with George C. Whipple, Assoc. M. Am. Soc. C. E., under the name of Hazen & Whipple, with offices at 220 Broadway, New York City. Mr. Whipple, who was formerly director of the Mt. Prospect Laboratory of the department of water supply, gas and electricity, will have charge of a department of testing and operating filters which the firm will establish.

T. R. Lemke of Berlin, Dr. Gruhl, Dresden; L. Zechel, Deuben; E. Wilkendorf, Coswig; Herman Hess, Waiblingen; Ewald Schroeder, Cologne; Frank Bressman, Kiel; E. Moelter, P. E. Borg and N. A. Lilje-krantz of Christianstad, Sweden, and I. W. Yander Eist, Zalt-Bommel, Holland, a representative delegation from the German Association of Clay and Cement Industries, arrived in this country June 9 to make a tour of the United States for the purpose of studying American methods of manufacturing brick, tile and cement. The principal works in this country will be visited and the party will later visit the St. Louis Exposition.

MACHINERY AND TRADE

The Latest Cement Block Machine.

The latest cement block machine which has come to the notice of the editor of this magazine is the Link-Hark, which has been invented by practical cement and foundry men, Messrs. Shaw and Harry, and which now embodies ideas developed from experiments made by Mr. F. P. Van Hook.

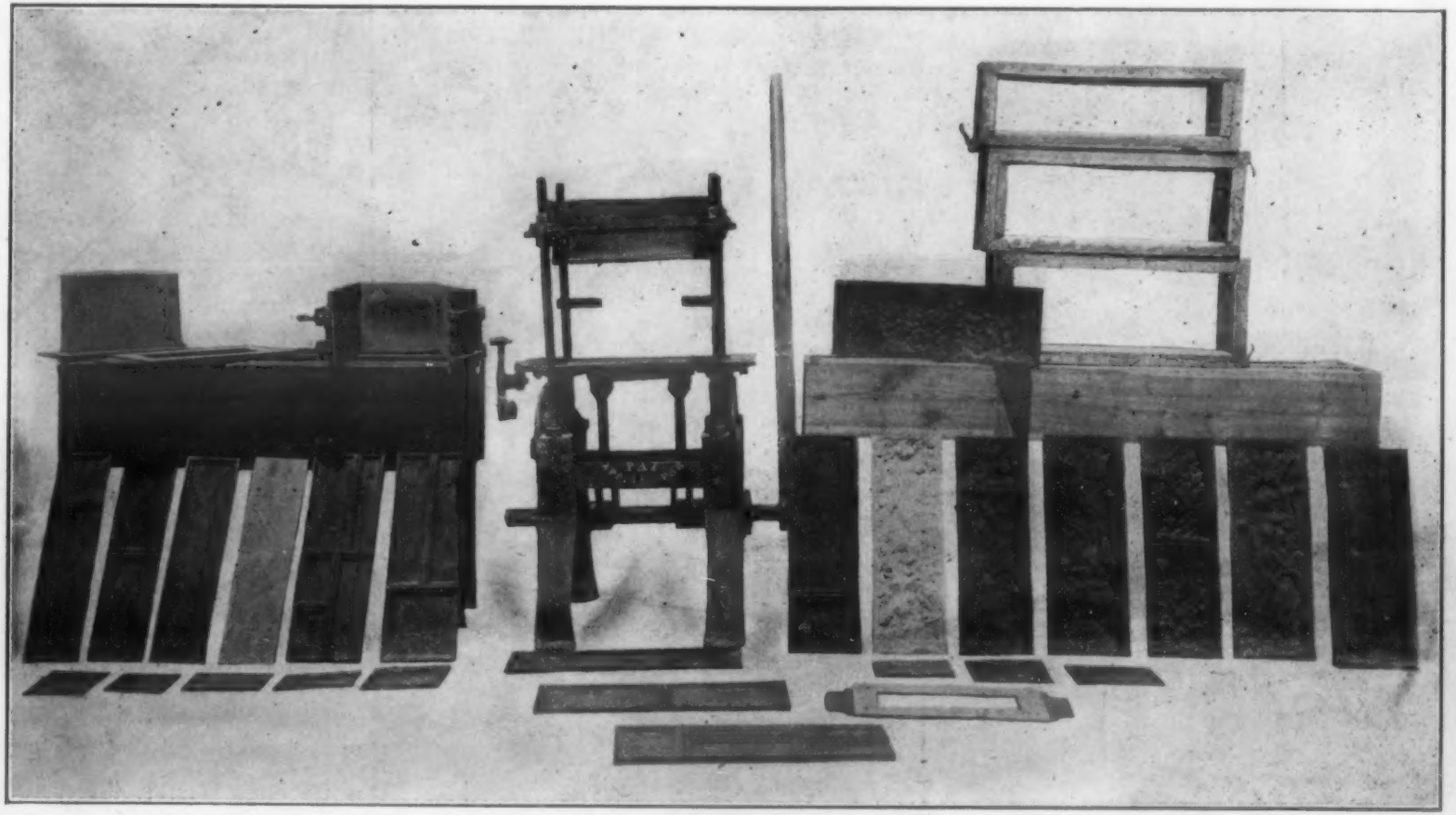
The machine itself, as shown in the accompanying photograph, consists of a cast iron frame with four rods supporting a straining plate near their upper ends, which is held in place against the pressure from below by nuts and washers. In the lower part of the frame is a shaft which is turned by the lever on the right of the machine. This shaft operates a toggle joint, which presses up the pressure plate, shown empty in the cut. On this plate is set the flask or mould in which the cement block is to be formed, filled with a concrete mixture, which contains more water than is usual with cement blocks which are tamped. When the mold is in place the lever is turned and the plate rises. The straining plate above is of proper size and shape to enter the mold and compress the concrete to the extent of the motion of the toggle joint below. The possibilities of the toggle point in applying great pressure with small power are well known, and it is estimated that each block made on the machine can be subjected to a pressure of five tons. When the pressure has been applied the lever is turned back, the plate and mold return to the original position and the mold is removed from the machine.

Any desired form of mold can be used, any desired face can be put on a block and any size of block can be made up to the capacity of the individual machine. The only change necessary in the machine is the change of the straining plate held by the nuts near the top of the corner rods. A number of faces called for by purchasers of the machine are shown in the cut, and these forms can be indefinitely increased in number.

The forms of mold or flask can be as numerous as the block manufacturer desires, and they may be made of any desired material. The cut shows on the right three wooden molds lined with sheet steel for making solid blocks, and on the left a cast iron mold and at the extreme left the core for making hollow blocks. In all the molds two sides are firmly joined together, the other two sides are joined to these two by hinges and the open joint is provided with a locking arrangement which is positive and quick acting.

In the operation of making a solid block the mold is set on a wooden pallet with proper guides and is shoveled full of the concrete mixture, these operations taking place on the table at the right of the machine. It is then put through the machine. The compression is such that a 6-inch block is made in a mold 8½ inches deep. The revolving stop for exactly locating the mold in the machine is seen on the left of the machine. The block is then run on the left hand table, the mold is removed and the block on its pallet is carried away to the curing shed, the mold being put in place at once for making another block. For a hollow block an iron pallet with a hole for the core is used, seen on the floor in the photograph, and also on the left-hand table. It is slipped over the core and rests on the plate to which the core is attached. The mold is then put round the core and the filling and emptying of molds proceed, as described above, except that the core is dropped out of the block by a light tap with the hand onto a support slightly below the top of the table through an opening in the table top.

A very important feature of the hollow block mold is the tapered core. The top of the core is ¼-inch smaller than the bottom. The result of the taper is to distribute the pressure used in forming the block horizontally as well as vertically, so that all parts of the block receive equal compression and are believed to reach equal density. The degree of moisture of the concrete is fixed to aid this action. A close-grained, solid block with voids closely filled and uniform in texture is thus obtained and at one motion of the operating lever. Careful examination of the manufacture of blocks in a mold with light and springing sides showed to the writer that this theory of



THE LINK-HARK CONCRETE BLOCK MACHINE.

the distribution of the pressure is correct.

A great practical advantage in this method of making blocks in addition to this unusual compression is the rapidity with which the machine can be operated. Thus ten hollow blocks, each 6 by 9 by 12 inches, were made in 10 min. 20 sec., or at a net rate of one block in 69 seconds, one being spoiled by careless cleaning of mold. Eleven solid blocks were made by two men in slightly less than 55 seconds each. Nine solid blocks of same size were made with a veneer of richer material than the body of the block in 54½ seconds, each with three men. In each case the materials were delivered at the machine ready mixed. This speed is remarkable, especially when the high quality and density of the blocks is remembered, but it has frequently been exceeded in regular work.

One of the forms of block which this machine can make of exceptional quality is a thin, solid block, about two inches in thickness, for veneering. This can be used to cover old brick buildings or as an outside finish for brick, rough stone or wooden walls of buildings or other structures.

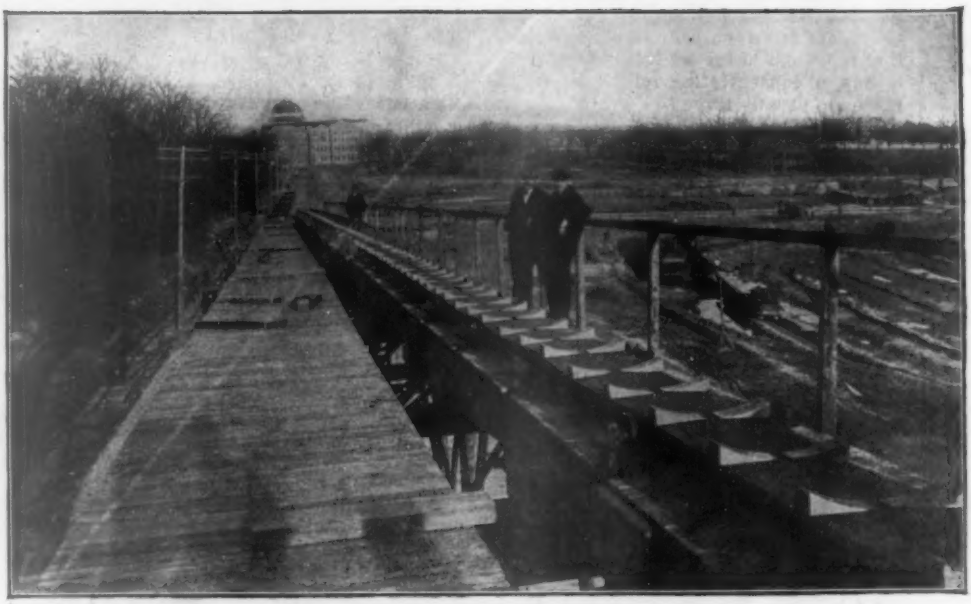
It will be noted that the blocks mentioned above are small and light enough to be handled by one man in laying and that they can be advantageously handled by bricklayers, since they can be laid much more rapidly than the brick which they take the place of. Any desired form or size can be provided for, however.

The sole selling agents of the machine are the Link-Hark Manufacturing Company of Bloomington, Ill., and it is the expressed intention of this company to make the best concrete block which it is possible to make. The fact that these blocks can be made so rapidly and therefore so cheaply is secondary in their minds, though it is a most attractive feature to the prospective purchaser of a block machine.

WASHINGTON FILTERS.
Two belt conveyor for sand and gravel.

Conveying Belts in the Concrete Plant at the Washington Filters.

The 75,000,000-gallon slow-sand filtration plant for Washington, D. C., which has been under construction since early in 1903, has reached the stage of progress at which large quantities of concrete are being placed. The belt conveyors in this equipment are of interest as being different from those with which engineers and contractors have become familiar from their frequent employment in other



TWO BELT CONVEYOR.
Inner belt in position with troughing blocks attached.

TWO BELT CONVEYOR.
Rollers for carrying inner belt.

places. The better-known types of belt conveyors have one belt, which is formed into a trough shape to hold the load by means of concentrating rollers, of which there are usually three in a set, one under the bottom of the belt and one on each side, the latter being set at an angle.

The type of belt conveyors at the Washington filters, however, makes use of two belts, an interior troughing and supporting belt and the load belt or conveying belt proper. The former runs over its individual head and tail pulleys, having separate take-ups, and is entirely independent of the latter. The carrying belt is threaded over its head and tail pulleys in the usual manner and has its separate take-up, so that the two belts, although moving together in the same direction at the same speed are entirely separate and distinct. This enables the conveying belt to be lifted off the supporting belt and out of the troughing blocks and passed through either a stationary dumper or a movable tripper.

The conveying belt has no work put upon it other than that required to drive the lower carriers and its own head and tail pulleys; all the carriers on the upper line, which comprise two-thirds of the total number used, being revolved by the inner supporting belt. The strains, therefore, are divided, the belt revolving two-thirds of the moving parts not being subject to the wear and tear of carrying the load, and the belt carrying the load being relieved of the strains and wear and tear of revolving the majority of the moving parts of the machine, and this results in considerable economy, it is claimed.

The interior belt is driven by a compensating drive from the main driving shaft, with the two belts in tension just sufficient to prevent slip on their driving pulleys; both belts move at exactly the same speed in the same direction and there is no rub of the conveying belt on the troughing blocks.

An accompanying illustration shows the carriers used in this system. They are straight rollers fastened to steel shafts revolving in babbitted boxes, the boxes being ball and socket, ring-oiling, felt-washered and dust-proof. By this method not only is cheapness attained in first cost, but power is saved and supervision is cut out as far as lubrication is concerned. A second view shows the interior troughing and carrying belt with its troughing blocks attached. The conveyor belt for the two-belt system is a machine-made belt with a protective cover. The inner or troughing belt carries the outer or conveying belt through the upper line of working travel and the outer belt carries the inner belt on its return. The ability to use straight rollers, all stresses being in compression and not bending, permits the use of light castings. This has a double advantage in reducing weight and cost and minimizing power. Only a clean belt comes in contact with the upper carriers. Other good points of the system will be apparent on examination.

The installation at the Washington filters was furnished by the Ridgway Belt Conveyor Company of 29 Broadway, New York, which owns the patents, fully protecting the system in both the United States and foreign countries.

Asphaltum from Indiana Oil.

At Asphaltum, Ind., is located the refinery of the Indian Asphalt Company, which refines Indiana oils and produces therefrom a large percentage of gum asphaltum for which many uses are found. Other products of similar nature are mineral rubber, asphalt paint and varnish and asphalt flux, besides various grades of oil. The gum asphaltum is presented as valuable for paving purposes, for filler in block pavements, for roofing, waterproofing or any place where a material not acted upon by water, water-proof and of a cementing nature is needed. The company, whose offices are in the Railway Exchange Building, Chicago, is also agent for the California Asphaltum Sales Agency, which represents a number of oil and refining companies in California.

World's Fair Guide Free.

The Studebakers have issued an attractive souvenir in connection with their extensive exhibits at the Louisiana Purchase Exposition, St. Louis, which while picturing a few of their more prominent styles in vehicles, harness and accessories, contains a map of the Exposition grounds, beautifully printed in colors, showing the location of every building and exhibit within the inclosure, and all marked in type easy to read.

The folder also contains a bird's-eye view of the grounds, and a street and railroad map of the city of St. Louis, showing how to get to the fair grounds and to other points of interest in the city.

Every intending visitor to St. Louis should take along one of these souvenir guides, which may be had free by addressing Studebaker Bros. Mfg. Co., South Bend., Ind., or calling at their exhibit in the Transportation Building.

Trade Publications.

Circular No. 46 of the American Asphaltum and Rubber Company, Woman's Tempie, Chicago, Ill., gives a good argument for the selection of asphalt for pavements on the same basis that other materials are selected and indicates the comparative advantages of Assyrian asphalt, which shows an excellent record of success as a paving material.

The Porcupine, a road scarifier, is illustrated in Circular No. 34 of Julian Scholl & Co., 126 Liberty-st., New York.

Electric locomotives for gathering purposes, especially in mines, capable of running short distances on spurs from the main line by use of portable electric cable are described in Bulletin No. 8 of the Jeffrey Manufacturing Company, Columbus, O.

Mr. Horace See, 1 Broadway, New York, has just perfected a device to be placed inside of hydrants which creates an interior protected channel for the passage of the water to the nozzle, with an air chmber which serves as a preventive of freezing, and further as cushion to protect the pipes against water hammer. A neat circular treats of it fully.

The ball bearing door hanger, though dating back about one year, has come to be recognized as a necessity by all builders, architects and others for elevator doors and heavy doors used for fire protection in stores, ware rooms, factories, etc. It makes them noiseless and gives easy running action and can be applied on any door that opens on a slide. A neat folder has been issued, giving a list of the prominent buildings in which they have been installed, with illustrations, etc. This will be mailed free to any one interested by addressing Reliance Ball Bearing Door Hanger Company, 1 Madison-ave., New York city. F. T. Ellithorpe, patentee of the celebrated air cushion for elevators, is the president.

Trade Notes.

ASPHALT.

The Colonial Asphalt Company, Plainfield, N. J., has been incorporated to deal in asphalt and cement, by Robert L. Kelly, Pierre, S. D.; Aaron D. Thompson, Plainfield, N. J.; E. Frank Vail, Plainfield, N. J.

Charles Fernald, assistant engineer of highways for the District of Columbia, has been inspecting asphalt fields in the vicinity of Havana, Cuba.

J. F. Aldrich of the Tacoma Concrete Company, Tacoma, Wash., is in need of a small asphalt mixer and a grinder for lump cement.

In the suit of Gen. Samuel T. Carnes et al. vs. Central Asphalt and Refining Company, Judge David E. Bryant of Sherman gave judgment for the plaintiff Carnes et al. for the amount of his vendor's lien notes, with interest and costs, together with a decree perpetuating the receivership of W. W. Talbert and ordering the receiver to sell either at public or private sale the property, consisting of an oil refinery near Port Neches, for an upset price of not less than $200,000. A number of claims of intervenors were also allowed. The date for the sale of the property was not named.

BRICK.

The Michigan Pressed Brick Company, recently organized to take over the Valley coal mine at Bay City, Mich., will manufacture paving brick.

CEMENT.

The Currie Cement Construction Company, Detroit, Mich., has been incorporated by William H. Holden, George E. Currie and Allan P. Cox.

The Hutchinson Cement Company, New York City, has been incorporated by I. C. Hutchinson, J. T. Call of New York City and A. A. Mitchell of West Brighton.

The Logan Portland Cement Company, Fenton, Mich., has closed a contract with the Elsie Bridge Company for the construction of a railroad from Fenton to the plant at Runyan lake.

The Forest City Contracting and Cement Company, Cleveland, O., has been incorporated by David Jones, F. W. Zeek, Mrs. M. McKee, F. C. Criend, E. J. Attel and M. A. Joy.

The Lancaster Portland Cement Company, Lancaster, Pa., has been incorporated by J. Frank Keller, Israel G. Erb, and Frank J. Reiber. The erection of a large Portland cement plant will begin at once.

The Wisconson Marl Company, Stevens Point, Wis., has been incorporated for the purpose of developing the marl beds of Lima lake, in the town of Amherst. The company will manufacture Portland Cement.

The Alpena Portland Cement Company, of Alpena, Mich., have been remodeling their plant, changing it from the wet to the dry process, under the supervision of Mr. Richard L. Humphrey, consulting engineer, Philadelphia.

The Ideal Concrete & Cement Company, Cambridge City, Ind., has been incorporated to manufacture and sell brick, cement building block, etc., by Daniel E. Petro, Willard Ulrich, Gustavus Garrett, Calvin C. Wissler and Alonzo F. Feemster.

The American Cement Company has been very fortunate in securing large contracts. They provided all the cement for the Rapid Transit Subway in New York, and also secured the contract for the new subway terminals of the New York Central Railroad. Their business is among the oldest in the manufacture of American Portland Cement, and has always been the largest.

The Urban Concrete Company, New York City, has been incorporated by Wm. A. Feigelstock, James W. Hoey and F. S. Gannon, jr.

The Maumee Cement Block Company, Maumee, O., has been incorporated by William Dennis, S. G. Eckenrode, W. J. McGarr, J. B. Ross and S. A. Jackson.

The Altoona Concrete Construction & Supply Company, Altoona, Pa., successors to the Frank Brandt Lumber Company, will build brick, wood, stone or cement block houses. Frank Brandt, prest. and gen'l mgr.

H. Schebye, 73 Lincoln-ave., Chicago, advises us that he has conveyed all rights for the manufacture and sale of the Kielberg molding press for making cement pipes in the United States and Canada to F. L. Smidth & Co., 39-41 Cortlandt-st., New York City.

Olaf Johnson, president of the Brookings Cement Block & Sidewalk Company, Brookings, S. D., will have on the market soon a new patent on cement pipe moulds, the first one out in the shape of common clay pipes. Mr. Johnson has applied for a patent on the mould.

Capitalists of Michigan, Illinois and Ohio have organized the United States Cement Brick Company and have closed contracts with the Mosaic Tile & Brick Cement Company of Detroit for the purchase of 500 cement brick machines. The company may be addressed care Board of Commerce, Detroit.

The Columbia Portland Cement and Marl Company, Madison, Wis., has been incorporated by John C. Prien, Prof. William H. Williams, Prof. C. A. Van Velzer, C. C. Wayland of Portage, Enoch Vernon, John Waterman and F. H. Merrell. The company has secured options on rich marl beds lying in the city of Portage and in the townships of Fort Winnebago, Pacific, Wyocena and elsewhere in Columbia county.

The largest contract ever awarded for Portland Cement has been granted to the American Cement Company of Philadelphia for their "Old Reliable Brand of Giant Portland Cement." This cement is to be used in the Pennsylvania tunnels under the North and East Rivers and in the terminal buildings in New York and Long Island City. The tunnel tubes, it will be remembered, are to be lined with cement, and the screw piles, on which the tunnels are to be carried, will be filled with cement. A great deal will also be used in lining the subway through Manhattan Island.

Judge Leathers, of the Superior Court, Indianapolis, Ind., has appointed the Union Trust Company receiver for certain intangible assets of the Midland Portland Cement Company, while refusing to interfere with the sale of the property of that company to the United States Cement Company. The intangible assets referred to are certain claims against officers of the company for excessive salaries, money received from alleged fraudulent sale of bonds and commissions received from sales. The court expressed doubt as to the right of receiver to be appointed for this purpose in Indiana, and was of the opinion that it should be done by the New Jersey court.

CONCRETE BLOCKS.

A. G. Peterson, Winthrop, Minn., is manufacturing sidewalk tile.

Albert Anderson, St. James, Minn., will manufacture cement building blocks.

The Pressed Cement Stone Works, Ellendale, N. D., is manufacturing building blocks.

A plant for the manufacture of hollow blocks is contemplated at Fairmont, Minn., according to press reports.

A company has been organized at Martinsville, Ind., by Messrs. Manderville and Sweet to manufacture cement blocks.

Barker & Black, Gilmore City, Ia., have purchased a Miracle hollow block machine and will manufacture building blocks.

The Winslow Lime and Cement Company, Petersburg, Ind., has been incorporated to manufacture building stone and cement building blocks.

The Hampton Cement Stone Company, Hampton, Ia., has been incorporated by T. C. Cartwright, F. A. Harriman, N. W. Neebe, Tom W. Purcell and A. R. Runward.

J. A. Mitchell of Hillsdale, Mich., has organized a company at Goshen, Ind., according to press reports, for the manufacture of concrete posts and building blocks. Burt Cripe and others are interested.

The Indiana Concrete Company, Evansville, Ind., has been incorporated to manufacture building blocks, concrete foundations, houses, bridges and other concrete structures, by H. B. Davidson, William A. Vilts and others.

James Maskiel, jr., 2 Welling-st., Long Island City, N. Y., advises us that he has purchased a Hercules cement stone machine from the Century Cement Machine Company, 181 W. Main-st., Rochester, for making concrete blocks.

Pettyjohn Bros., Terre Haute, Ind., advise us that their machines and systems of making concrete blocks are being used in recently established plants for the manufacture of hollow concrete building blocks as follows: Messrs. Bennett & Dodd, Farmersburg, Ind., two machines; Messrs. Cutshall & Flagg, Brazil, Ind., two machines; Messrs. Frost & Son, Jerseyville, Ill.; Edward Jennens, Indiana Harbor, Ind.; Snyder & Leggett, Greenup, Ill.; J. W. S. Eddy, Regina, Assa., Canada; Gaston Bishop, Westhampton, Long Island, N. Y.; Gray & Stewart, Portland, Ind.; Elmer L. Stanton, Schenectady, N. Y.; L. F. Champlain, Lake City, Minn.

A new plant for the manufacture of cement shingles has been completed at Roswell, N. Mex.

Cement bricks are being manufactured at Kalkaska, Mich.

The United States Circuit Court for the Western District of Kentucky at Owensboro, June 2, issued an injunction against Spayd and Bennett restraining them from making or selling any machine or apparatus for making building blocks em-

bodying or employing the inventions and improvements made and claimed by H. S. Palmer in patents Nos. 375,377, Dec. 27, 1887; 623,686 April 25, 1899; 727,427, May, 5, 1903, and 727,728, May 5, 1903.

PURCHASE OF MACHINERY AND TOOLS.

We have been directly advised by the following people that they are possible purchasers of machinery and tools as follows:

William Watkins, 614 Sutter-st., San Francisco, Cal., machines for hollow concrete blocks and mixers.

I. E. Phelps, Wahoo, Neb., building block machinery.

William Jewell, Manchester, Ia., cement tools.

Frank Peifly, Greensburg, Pa., sand crushing, grinding and washing machinery.

Hugues Brussel, C. E., 306 Benoist building, St. Louis, Mo., mixers, hoisting engines and elevators, pile drivers and cement block machine.

J. F. Aldrich of Tacoma Concrete Company, Tacoma, Wash., small asphalt mixer and grinder for lump cement.

Koepke Bros., Petoskey, Mich., brick and stone masons' machinery.

Lee Howland, Charlevoix, Mich., trowels, corner turner, curb tools, etc.

Edward Kneezell, Arch., El Paso, Tex., septic tanks.

PURCHASE OF MATERIALS.

F. J. Manley, C. E., Harriman, Tenn., advises us that he is a possible purchaser of Portland cement delivered in Kentucky and Tennessee.

Edward Kneezell, Arch., Ed Paso, Tex., advises us that he is in the market for materials of all kinds for building purposes.

Koepke Bros., Petoskey, Mich., is a possible purchaser of contractors' and builders' materials.

We are directly advised that the following people are interested as possible purchasers of cement.

Hughes Brussel, C. E., 303 Benoist Bldg., St. Louis, Mo.

William Jewell, Manchester, Ia.

I. E. Phelps, Wahoo, Neb.

Francis H. Wright, cy. engr., Helena, Ark., advises us that he is interested as a possible purchaser of steel plates, steel reinforcements and crushed stone.

LIGHTING AND POWER.

The Incandescent Supply Co., Cincinnati, O., has been incorporated by L. F. Dawson, L. C. Harger, Oliver G. Bailey, Frank H. Williams and Edwin J. Howard.

The A. G. Kaufman Mfg. Company, New York City, has been incorporated to manufacture gas appliances, by Rudolph Pieffer, A. G. Kaufman and V. Schenck.

The Pacific Electric Co., Ontario, Cal., has been organized and incorporated to engage in the manufacture of electrical devices and appliances, by E. H. Richardson, M. Richardson, B. C. Shepherd, C. A. Shepherd and T. E. Parke.

NEWLY INCORPORATED LIGHTING COMPANIES

Carrollton Heat, Light and Power Co., Carrollton, Ill.—Robert H. Bigger, F. M. Sinsbaugh, W. D. Moore.

Searsport Electric Light Co., Searsport, Me.—Harry L. Crem, A. J. Desmond of Portland.

York Engineering Co., York, Pa.—H. H. Lindemuth, W. H. Myers, E. S. Lewis.

Edmeston Light, Heat & Power Co., Edmeston, N. Y.—Chas. T. Coats, Homer Underwood, C. W. Hopkins.

Commonwealth Electric Co., Jersey City, N. J.—Graham Sumner, Ross A. Mackey, Mark Hyman.

American Electric Lighting Co., Louisville, Ky.—Chas. A. Hess, Mary Rosenfield, Louis F. Otts, Thos. F. Condon.

The Continental Gas Machine Co., Minneapolis, Minn., has been organized by I. D. Cooper, W. E. Ford, R. G. Ford and H. B. Cornish.

The Free-Piston, Gas Engine Co. Detroit, Mich., has been organized to manufacture gas engines, by Henry C. Hart, George Maitland, E. J. Stoddard and Chas. F. Burton.

MISCELLANEOUS.

The American Concrete-Steel Bridge Co., Portland, Me., has been organized to build bridges by Millard W. Baldwin and W. A. Castner of Portland.

The village council of Yellow Springs, O., has purchased a new stone crusher of the Indiana Road Machine Co., of Fort Wayne, at a cost of $90, including machines, elevators, screens, chutes, etc.

The Western Indiana Hydraulic Stone Co., Terre Haute, Ind., has begun the erection of a plant for manufacturing artificial stone.

The National Bridge Works, Jersey City, N. J., has been incorporated by Theodore J. Foster, Robert Giles, Elliott C. Smith and John J. Guinnane.

S. Pearson & Son of New York city has been incorporated to build a tunnel between the boroughs of Manhattan and Queens, under the East River. The directors are E. W. Moir of London, England, George W. Wyckersham, Henry W. Taft, John F. Charlton and Arthur C. Patterson of New York city.

The Syracuse Bridge Co., Syracuse, N. Y., has been incorporated by A. H. Mallery, O. M. Wood, Syracuse, N. Y., and G. E. Sickman, Newark Valley, N. Y.

The Moline Paving and Construction Company, Moline, Ill., has been incorporated by J. B. Coykendall, J. L. Horton and E. Stanley Skinner.

SEWER PIPE.

The general offices of the American Sewer Pipe Company are now located on the eleventh floor of the new Bessemer Building, Sixth-st. and Duquesne Way, Pittsburg.

The American Sewer Pipe Company's Pittsburg offices are now located on the eleventh floor of the new Bessemer building at Sixth-st. and Duquesne-way.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Tacoma, Wash.—This city is considering a proposition to sprinkle the streets and roads with crude oil during this summer.

Bay City, Mich.—Frank I. Consaul, City Engineer of Toledo, O., visited this city June 21 for the purpose of examining the filler used in the brick pavements in this city. The filler was furnished by the American Asphalt and Rubber Company of Chicago. Mr. Consaul claimed that he had never seen brick pavements in as good condition as those in this city.

Des Moines, Ia.—Judge Brennan handed down a decision June 16 annulling the paving contracts affecting the alley between Crocker and School-sts., between Fifth and Sixth-sts. The paving assessments are annulled and the temporary injunctions against the city and the contractors to prevent the completion of the work are made permanent.

New York City.—The appellate division of the Supreme Court has reversed the verdict obtained by Edward R. Dunn against the Hastings Pavement Company for $75,567 for services, which consisted in procuring contracts for asphalt paving. It was argued that this work consisted largely in lobbying in the Board of Aldermen. Dunham's contract was void, as it was contrary to public policy and interest, and, therefore, illegal. A new trial has been ordered.

New York City—A resolution has been adopted by the board of estimates which provides that no asphalt which is the product of the distillation of petroleum shall be accepted for asphalt paving. The resolution as presented included the entire city, but Martin W. Littleton, president of the borough of Brooklyn, asked to have that borough excluded from the effect of the ordinance, which was granted. At the time the ordinance was passed it was thought that its object was to exclude only Trinidad asphalt, which, according to President Ahearn, had proved unsatisfactory, but it also restricts companies using some California asphalts from bidding.

Cincinnati, O.—Mayor Fleischmann returned, with his disapproval, June 17 an ordinance for paving Walnut-st. from Fourth to Court by resurfacing with asphalt, and Main-st. from Fourth to Court. These ordinances were passed June 13. Mayor Fleischmann's reason for disapproving the ordinances is that they provide that the improvements shall be made under the specifications now in force. New specifications for asphalt and other paving materials are now under consideration by the council, and will in all probability be adopted within a very short time. This is a decisive step in a fight which has been going on since about the first of June, in which Mayor Fleischmann leads in an effort to secure open specifications in bids for asphalt paving, and also for the admission of bitulithic macadam. The Barber Asphalt Company offers strong resistance to opening the specifications.

CONTEMPLATED WORK.

Shenandoah, Ia.—The question of paving is being urged.

Waverly, Ia.—Council has ordered six blocks of streets paved.

Dubuque, Ia.—About 5,100 square yards of brick paving is contemplated.

Oelwein, Ia.—Brick paving is contemplated for a number of streets.

Gibson City, Ill.—Council voted to pave nine and one-half blocks of Sangamon-st.

Springfield, O.—Contracts will be let about July 15 for street paving.

Canton, Ill.—The estimated cost of paving W. Walnut-st. with brick is $15,250.

Manchester, N. H.—Orange-st. is to be macadamized and the gutters paved.

Butler, Pa.—City Council has decided to pave Franklin-st. City Engineer Harper.

Moline, Ill.—Petitions are being circulated for paving Eighteenth-ave. with brick.

Webb City, Mo.—Paving is proposed for Allen and W. Daugherty-sts. Mayor Moore.

Hutchinson, Kas.—The question of paving W. Sherman and Adams-sts. is being urged.

Felton, Minn.—The village coun. has granted a petition for building sidewalks on Sixth-st.

Eau Claire, Wis.—Brick gutters and crosswalks are contemplated on a number of streets.

Sioux Falls, S. D.—Cement walks will be constructed on Minnesota-ave. and Harmony-st.

Ottumwa, Ia.—Final action will be taken July 11 on the proposed paving of Marion-st.

Fremont, Neb.—An ordinance has been passed for paving F-st., from First to Fifth, with brick.

Havelock, Neb.—The business men are agitating the question of paving Jackson-st. with brick.

Whiting, Ind.—About 2 miles of concrete sidewalks and curb is contemplated. G. W. Jones, cy. clk.

Miamisburg, O.—The residents on S. Main-st. have petitioned for street paving. Mayor Stocker.

Louisville, Ky.—Bids will be asked for

paving six blocks of streets with asphalt and five blocks with brick.

Niagara Falls, N. Y.—Common coun. has declared its intention to pave Tenth-st. at a cost of $4,542.10.

St. Paul, Minn.—Preliminary orders for building several miles of cement sidewalks have been passed.

Braddock, Pa.—The question of voting on a bond issue for street improvements will be voted on Aug. 2.

Danbury, Conn.—A hearing will be given, July 13, on the proposed macadamizing of Balmforth-ave. C. O Brown, cy. engr.

Washington, D. C.—The District comrs. have ordered Tenth-st. between Frankfort and Hartford-sts. graded and macadamized.

Traverse City, Mich.—The question of paving three blocks of business streets with vitrified brick will be voted on.

Warren, Ind.—Grading, curbing and macadam paving is proposed for S. Tod-ave. from W. Market-st. to Parkman-road. Mayor Sloan.

Canton, O.—Resolutions have been adopted for curbing and constructing flagstone sidewalks on Maple-ave. and Elizabeth-st.

Delaware, O.—A resolution has been adopted to pave Sandusky and W. Winter-sts. with hard-burned brick. Mayor Clippinger.

Baltimore, Md.—Baltimore-st. from Liberty to Gay is to be paved with new Belgian blocks on concrete base. B. T. Fendall, cy. engr.

Jeffersonville, Ind.—Plans for 2-mls. of granitoid walks are being prepared by Victor W. Lyon, cy. engr., and bids will be asked soon.

San Jose, Cal.—The bds. of supervisors of Santa Clara and Santa Cruz counties decided June 12 to build a joint county road 7 miles long.

Hartney, Man.—The municipal coun. has decided to purchase a road grader, at cost of $1,600, to be used at once in the vicinity of the town.

Rockford, Ill.—An ordinance has been passed to build concrete tar sidewalks on Madison-st. Charles E. Jackson, mayor; H. C. Scoville, city clerk.

Monticello, Ill.—The county board has authorized its chairman to sign a petition for paving the court house square. Asphalt and brick is being considered.

Jerseyville, Ill.—The board of public improvements took preliminary steps July 8 to pave the principal streets of this city with vitrified brick. George B. Docke, Mayor.

Burlington, Ia.—A resolution has been introduced providing for grading, curbing with artificial stone, and paving with brick West-ave. C. W. Droegemeyer, Cy. Clk.

Auburn, N. Y.—New specifications have been ordered prepared for paving North-st., to include brick. Garden and Water-sts. and Hamilton-ave. will also be paved. Cy. Engr. Ackerman.

Duluth, Minn.—Bids will be asked for paving 9 blocks of London road with macadam and improving first alley, from Lake to Fourth-ave. less W. and E. Fifth-st. from Woodland to Twenty-third-ave., east.

South Bend, Ind.—About 12,000 sq. yds. of macadamizing is contemplated at once and 25,000 sq. yds. later, for the streets of Navarre-place, in this city. N. L. Otis, secy. Home Improvement Company.

Portland, Ore.—Ordinances have been passed for paving Lownsdale and Main-sts. with macadam and Benton-st. with gravel, with artificial stone sidewalks and stone gutters. Thomas C. Devlin, cy. audt.

Buffalo, N. Y.—Special—Notice of intention has been given for the following: Repaving Sixteenth-st. from York to Vermont, with Trinidad asphalt; Seneca-st. from Babcock to Peabody with dressed block Medina sandstone; Bond-st. from Howard to Oneida, Trinidad asphalt. Charles F. Susdorf, cy. clk.

Lincoln, Ill.—Special—Robert M. Berry, cy. clk., advises us that the city council has passed ordinances and bids will be received about Aug. 1 for paving with brick blocks on concrete foundation and combined concrete curb and gutter, as follows: Broadway, 1,200 ft.; Elliott, Short, Delavan-sts., 2,242 ft.; Pekin-st., 700 ft.; S. Logan, 728 ft.; College-ave., 2,135 ft., and Ninth-st., 1,296 ft., are to have asphalt filler between brick joints.

CONTRACTS TO BE LET.

Ashland, Wis.—Bids are asked until July 19 for constructing sidewalks. B. P. W.

Butte, Mont.—Bids are asked until July 6 for building cement sidewalks. Cy. clk.

Spencer, Ind.—Bids are asked until July 5 for macadamizing pike road in Jefferson twp. Co. audt.

Moberly, Mo.—Bids are asked until July 5 for paving Lee-st. with brick. John F. Curry, cy. clk.

Marion, Ind.—Bids are asked until 8 p. m. July 5 for improving several streets C. G. Robbins, cy. clk.

Dillon, Mont.—Bids are asked until July 19 for constructing 3½ miles of country road. John S. Baker, cy. clk.

Sullivan, Ind.—Bids are asked until July 14 for constructing gravel and stone roads. J. M. Lang, co. audt.

Metamora, Ill.—Bids are asked until July 5 for building 10,000 feet of concrete sidewalks. F. Giehl, Sr., Mayor.

Leavenworth, Kas.—Sealed bids are asked until July 6 for artificial stone curbing for three blocks of streets. Cy. clk.

Oberlin, O.—Sealed bids are asked until July 19 for paving Cedar-ave., from W. Lorain to Morgan-st. O. F. Carter, mayor.

Allentown, Pa.—Bids are asked until July 9 for constructing 11,445 feet of road in Whitehall twp. State Highway Dept., Harrisburg.

Albany, N. Y.—Sealed bids are asked until 12 m. July 8 for improving a num-

ber of highways. Henry A. Van Alstyne, State engr. & surv.

Cincinnati, O.—Sealed bids are asked until July 12 for resurfacing Seventh and Ninth-sts. with asphalt. Geo. F. Holmes, B. P. S.

Ottawa, O.—Sealed bids are asked until July 20 for constructing stone roads in Monroe and Liberty twps. O. C. Talbott, co. surv.

Winona, Minn.—Bids are asked until 8:30 p. m. July 5 for paving Walnut-st., from Second-st. to Mississippi river. Cy. Engr. Coleman.

Winchester, Ind.—Sealed bids are asked until 8 p. m. July 6 for macadamizing East-st. T. W. Hutchins, mayor; C. C. Yunker, cy. clk.

Wyoming, O.—Sealed bids are asked until July 6 for macadamizing Walnut-ave., from Springfield to Elm-aves. W. A. Clark, vil. clk.

Paoli, Ind.—Sealed bids are asked until July 7 for constructing gravel or macadamized roads in Orleans twp. G. W. Tegarden, co. audt.

Laporte, Ind.—Bids are asked until July 8 for constructing macadamized roads in Center and Coolspring twps. Chas. H. Miller, co. audt.

Cincinnati, O.—Sealed bids are asked until July 12 for resurfacing with asphalt 7th st. from Vine to Carr. Geo. F. Holmes, clk. B. P. S.

Amsterdam, N. Y.—Sealed bids are asked until July 5 for paving Division st. with brick on concrete base. Thos. J. Hazlett, cy. clk

Hammond, Ind.—Sealed bids are asked until 7:30 p. m., July 12, for macadam paving and concrete curbing on Condit st. W. F. Bridge, cy. engr.

Connersville, Ind.—Sealed bids are asked until July 4 for building cement walks on Eastern ave. and 21st and 3rd sts. Jacob S. Clouds, cy. clk.

Fort Dodge, Ia.—Sealed bids are asked until July 20 for brick and asphalt paving and concrete curb on 12th st. and 4th ave. C. H. Reynolds, cy. engr.

Corydon, Ind.—Sealed bids are asked until 1 p. m., July 6, for constructing free gravel roads. Geo. H. Mathes, chm. co. comrs.; Frank E. Watson, so. audt.

Cleveland, O.—Sealed bids are asked until July 6 for furnishing jetties and riprap in Cuyahoga river at Five-mile Lock Bridge. Julius C. Dorn, clk. co. comrs.

Bloomington, Ind.—Bids are asked until July 7 for constructing the Fairview-st. pike and Ellettsville and Martinsville extension. Samuel L. Kerr, co. audt.

Marinette, Wis.—Sealed bids are asked until July 7 for paving Hosmer and Ogden-sts. with vitrified brick. Jacob Wittig, chmn. B. P. W.; A. L. Hillis, cy. engr.

Vicksburg, Miss.—Bids are asked until 12 m. July 4 for putting down terra cotta gutter on Jackson-st. and lowering gutter on Grove-st. J. D. Laughlin, clk. bd. supvrs.

Marengo, Ind.—Sealed bids are asked until 2 p. m. July 9 for macadamizing certain highways in Liberty twp. Philip N. Smith, chmn. co. comrs.; Samuel E. McFall, co. audt.

Bedford, Ind.—Sealed bids are asked until 1 p. m. July 5 for constructing gravel or macadam roads in Bono twp. Amos W. Scoggan, chmn. co. comrs.; Walter G. Ownes, co. audt.

Pittsburg, Pa.—Sealed bids are asked until July 16 for permanent improvement of Coultersville, Camp Meeting, Foster and Monroeville roads. R. J. Cunningham, co. com.

Sacramento, Cal.—Sealed bids are asked until July 5 for macadamizing H-st., from Seventh to Twentieth, and until July 11 for paving Twelfth-st. with macadam. M. J. Desmond, cy. clk.

Summitville, Ind.—Sealed bids are asked until July 5 for constructing 5,000 sq. yds. of cement sidewalks on various streets. M. H. Downey, cy. engr.

Jacksonville, Fla.—Bids are asked until July 11 for 1,741 sq. yds. vitrified brick paving and 693 ft. stone curbing. Philip Prioleau, cy. engr.

Muncie, Ind.—Bids are asked until July 11 for constructing walks on various portions of Mulberry-st., and for improving Walnut-st. R. G. Hickok, cy. clk.

Monroe, Wis.—Sealed bids are asked until 6 p. m., July 5, for 14,000 sq. yds. macadam paving and 8,500 lin. ft. cement curb and gutter. Miles T. Gettings, cy. clk.

Oceanic, N. J.—Bids are asked until July 13 for constructing a stone road 1½ mi. long from this town to Rumson-road. John Guire, dir., Long Branch, N. J.

Matawan, N. J.—Bids are asked until July 13 for constructing ¾ mi. macadam road with gravel wings between Matawan and Keyport. John Guire, dir., Long Branch, N. J.

Brooklyn, N. Y.—Sealed bids are asked until July 6 for repaving with asphalt, asphalt block and Medina sandstone and building cement sidewalks. Martin W. Littleton, prest. boro.

Cleveland, O.—Sealed bids are asked until July 6 for paving the south approach of the Brooklyn-Brighton bridge with brick, and until July 13 for grading Euclid-road. Julius C. Dorn, co. clk.

Vernon, Ind.—Sealed bids are asked until July 5 for constructing pike roads in Sand Creek, Spencer, Geneva and Columbia twps. James W. Clarkson, chm. bd. co. comrs.; W. S. Campbell, co. audt.

Lawrence, Kas.—Sealed bids are asked until 12 m July 4 for grading, curbing and paving Rhode Island-st., from Winthrop to Lee; repairing gutters on Lee, Hancock and Quincy-sts. Samuel P. Moore, cy. clk.

Cumberland, Md.—Sealed bids are asked until July 7 for paving Rebecca and Polk-sts. with vitrified brick, and constructing curbing and sidewalks on Virginia-ave. W. A. Cornwell, chmn. st. and alley com.

Richmond, Ind.—Sealed bids are asked until July 4 for cement curb and gutter on S. Thirteenth-st., from B to C, and for building sidewalk of Starr brick or cement on S. Ninth-st. and S. F-st. John F. Taggart, cy. clk.

Indianapolis, Ind.—Sealed bids are asked until July 6 for paving Highland-ave., from Washington to Marlowe-sts., with asphalt, and constructing cement sidewalks on a number of streets. M. A. Downing, chmn. B. P. W.

Buffalo, N. Y.—Sealed bids are asked until 11 a. m. July 8 for macadamizing Dorchester-road, from Baynes-st. to Richmond-ave., and for repaving Michigan-st. from Scott to Ohio-sts. Francis G. Ward, comr. pub. wks.

Salem, Ind.—Sealed bids are asked until July 5 for constructing 2½ miles of gravel or macadam road in Washington Twp., known as the "Old Corydon" road. William M. Brannaman, chmn co. comrs.; Frank E. Morris, co. audt.

Towson, Md.—Bids are asked until July 14 for furnishing material and paving First-st., Highlandtown, as follows: Excavating 3,900 cu. yds.: brick or block paving 11,704 sq. yds. on 1-in. sand cushion and cement filler; granite or limestone curbing 3,868 lin. ft. H. G. Sjirley. cy. engr.

CONTRACTS AWARDED.

Sterling, Ill.—The contract for 5 blocks of brick paving was awarded to Timothy Rourke for $13,302.59.

Denver, Colo.—The contract for surfacing dist. No. 2 was awarded to Hugh Murphy of Omaha for $34,820.

Harrisburg, Pa.—The contract for paving Blackberry-ave. with brick was awarded to George B. Stucker.

Findlay, O.—The contract for paving W. Sandusky st. has been awarded to C. H. Burchinal of Toledo for $16,007.

Oklahoma City, Ok.—Fuller & Hipple have been awarded the contract for paving certain alleys with brick on concrete base.

Lapeer, Mich.—The contract for paving Nepessing-st. with brick was awarded to Lynch & Cotharin of Flint, at $1.54 a sq. yd.

Fulton, N. Y.—John Hendricks of Oswego secured the contract for macadam paving on S. 4th-st. and 3rd-st., for $17,000.

St. Paul, Minn.—The contract for graveling Summit-ave., from Dale to Cleveland, was awarded to Dickson & Moore for $41,979.60.

Bridgeport, Conn.—The contract for paving Middle and E. Main-sts. was awarded to Silliman & Godfrey. Vitrified brick will be used.

Lockport, N. Y.—C. W. Stainthorpe & Co. was awarded the contract for curbing, guttering and paving Elm-st. with brick for $13,383.

Montgomery, Ala.—The contract for paving in district No. 3 was awarded, June 12, to the Republican Chemical Works at $2.06 a sq. yd.

Detroit, Mich.—The Cleveland Trinidad Company has been awarded the contracts for paving sections of Charlotte, Willis and Elizabeth-sts.

Philadelphia, Pa.—The contract for asphalt paving and repaving was awarded, June 17, to the Barber Asphalt Paving Company at $1.99 a sq. yd.

Lansing, Mich.—The contract for building stone sidewalks was awarded, June 13, to the Lansing Artificial Stone Company at 9½ cts. a sq. ft.

St. Joseph, Mo.—The St. Joseph Street Construction Company was awarded the contract for paving Fourth and Second-sts. with asphalt at $1.60 a sq. yd.

Fort Plain, N. Y.—The contract for paving Main, Division and Center-sts. was awarded, June 20, to Fred Schuyler of this place for $7,900.

Wellston, O.—The contract for 4,200 sq. yds. of brick paving and 600 ft. of sewer pipe was awarded to John Francisco of Ironton for $7,429.63.

Little Falls, N. Y.—Hallinan Bros. secured the contract for paving W. John-st. with brick for $13,400, and for leveling Girvan square for $698.

Charlotte, Mich.—The contract for paving N. Cochrane-ave. with Metropolitan brick on gravel foundation was awarded to G. H. Neal of Lansing.

Philadelphia, Pa.—The contract for macadamizing 25,550 feet of road between Kennett and West Grove was awarded to Patrick H. Cochrane for $29,175.

Chicago, Ill.—The contract for furnishing 600,000 Belgian blocks for paving purposes was awarded to the Georgia Rough & Cut Stone Company of Augusta, Ga.

New Orleans, La.—The contract for repairing the asphalt pavement on Chartres-st., from Canal to St. Louis, was awarded to the Sicilian Asphalt Paving Company.

Richmond, Va.—The contract for paving with asphalt blocks was awarded to the Washington Asphalt Block & Tile Company of Washington, D. C., for $30,000.

Utica, N. Y.—The contract for paving Miller-st., from Square-st. to the West Shore R. R., was awarded, June 17, to the Interstate Paving Company for $9,886.05.

Columbus, Ga.—The contract for constructing a granolithic pavement around the postoffice building was awarded to the M. H. Tuggles Concrete Company of this city.

Sycamore, Ill.—The Thomas J. Peter Company of Chicago was awarded the contract for completing the asphalt paving on State-st., which the Federal Asphalt Company had begun.

Belvidere, Ill.—The contract for completing the asphalt paving, for which the Federal Asphalt Company had contracts, was awarded to the Thomas J. Peter Company of Chicago for $34,497.

Cincinnati, O.—Thomas L. Gleason was awarded the contract for macadamizing Marshall-ave. for $3,610.54, and E. S. Gleason the contract for brick paving on Kossuth-st. for $3,977.96.

Scranton, Pa. — The Barber Asphalt Paving Company secured the contracts for paving Forest Court, between Spruce and Linden, at $2.44, and Moir Court, between Mulberry and Vine, at $2.56 a sq. yd.

Brooklyn, N. Y.—The Brownsville Im-

provement Association awarded the contract for 20,000 sq. yds of asphalt paving through its property in the Brownsville district to the Uvalde Asphalt Company

Ft. Wayne, Ind. — L. H. McAfee was awarded the contract for grading and building sidewalks on Alliger-st. at $1.09 a lin. ft., and the Moellering Construction Company a contract for sidewalks on Walton-ave. at 44 cts.

Evanston, Ill.—Paving contracts have been awarded as follows: Clark-st., M. Foley, $2,784.35; Crain-st., Smith & Brown, $8,564.50; Oak-ave., M. Foley, $3,342.60; Sheridan-road, John A. McGarry & Co., $50,117.

St. Joseph, Mo.—The Phoenix Brick and Construction Company was awarded contracts June 13 as follows: Grading and brick paving an alley, $1.85 a sq. yd.; remacadamizing Messanie-st., $1.60; grading and paving an alley, $1.85.

Pittsburg, Pa.—Contracts were awarded June 7 as follows: Grading Orion-st. J. B. Sheets & Co., $735.52; paving same with asphalt, Booth & Finn, $13,755; grading, paving and curbing Eureka-st., Booth & Flinn, $13,181.40.

Lincoln, Neb.—Hugh Murphy of Omaha secured the contracts for asphalt paving with brick gutters in districts Nos. 28, 30, 31, 32, 35, 44 and 48, at $2.10 a sq. yd. for asphalt and $1.90 for brick, and for repaving, $1.85 and $1.30 respectively.

Buffalo, N. Y.—(Special.)—Paving contracts have been awarded as follows: Repair of all asphalt pavements out of guaranty and not beyond repair, Rock Asphalt & Cement Co., Ltd.; repaving Clinton-st. with dressed Medina sandstone, F. V. E. Bardol, $32,000.

St. Paul, Minn.—The Barber Asphalt Paving Company was awarded contracts, June 21, for paving as follows: E. Tenth-st., $12,315; E. Ninth-st., $14,100; Lawton-st., $3,961. The contract for paving Rosabel-st. with brick was awarded to Fielding & Shepley, for $3,150.

Milwaukee, Wis.—The Western Paving and Supply Company secured the contracts for asphalt paving on Marietta, Summit and Shepard-aves. at $2.27 a square yard. Fred Hildebrand was awarded the contract for brick paving on River and Market-sts. at $2.02 a square yard.

Binghamton, N. Y.—The contract for paving South-st. with brick was awarded June 20 to Arthur D. Osborne at $1.73 a square yard for Scranton wire-cut brick. A. L. Willey was awarded the contract for paving Clinton-st. with Park brick on gravel and concrete base, at $1.85 a square yard.

Indianapolis, Ind.—Bids were received, June 22, for paving an alley with brick as follows: J. D. Hoss, $1.09; George W. McCray, $1.11; Indianapolis Construction Co., $1.13; J. E. Sullivan was awarded a contract for building cement walks in Webster-ave at 83 cents a lin. foot and Isaac King the contract for cement walks in Prospect-st. at 61¾ cents a lin. foot.

Rochester, N. Y.—Contracts were awarded June 8 as follows: Asphalt paving, Rock Asphalt Paving Company, $4,045.15; cement walks, Rustic-st., $703.50, and Avenue A, $615, Herman Miller. Contracts were awarded, June 16, as follows: Asphalt paving, Sellinger-st., Rochester Vulcanite Pavement Company, $9,297.50; cement walks, Eiffel-st., Herman Miller, $434.50; Avenue D, John Regan, $728.50; brick paving, Niagara-st., F. A. Brotsch, $10,994.

Albany, N. Y.—Contracts for the improvements of State highways were awarded, June 16, to J. T. Finch, Glens Falls; H. P. Burgard, Buffalo; F. Pidgeon, Saugerties; Simpson Bros., Phoenicia; S. B. Vanwagoner, Rondout; D. B. Joselyn; A. Schupp, Albany; C. H. Quereau, Baldwinsville; Chambers & Grady, Rochester; Casey & Murray, Rochester; J. Anderson, Glens Falls; Mott & Kemper, Johnstown; Mosier & Summers, Buffalo; Thos. H. Karr, Troy; W. H. Masterson, N. Y. City; M. F. Dollard, Albany; Lord & Merchant, Nassau.

Albany, N. Y.—Contracts for constructing State highways were awarded, June 7, as follows: Buckley Const. Co., of Schenectady—road No. 179, Schenectady Co., $25,000; East Mohawk turnpike No. 180, $23,500; Broadway Fort Hunter rd., 180, $23,500; Broadway—Port Hunter rd., ter—Middletown State Hill rd. No. 159, $13,115.20. Orange County Road Const. Co.—Slate Hill—Unionville rd., No. 160, $45,200; Newburgh—Shawangunk, No. 161, $48,250. Joseph Walker—Oneonta rd. No. 162, $10,528. Anderson & Britton—Little Ridge rd., No. 165, $13,437. H. P. Burgard—Penfield rd., sec. 1, $27,500; sec. 2, $30,500. Mosier & Summers, Buffalo—Dugway rd., sec. 1, $31,400; sec. 2, $18,272; sec. 3, $13,400. H. C. Schroeder, Rochester—Lake rd., sec. 1, $13,400. County of Broome—Endicott rd., No. 174, $19,900; Chenango towpath rd., No. 175, $9,998.50.

Takoma Park, Md.—Bids were received June 20 for constructing cement sidewalks as follows: Class 1, sidewalks, including curb or fill of 1 ft., with guarantee for 5 yrs., accompanied by bond for that period: Rosser & Castoe of Bellaire, Ohio, $1.12½; Brennan Construction Company of Washington, D. C., $1.17; Warren Brothers Company, Washington, D. C., $1.21½; Cranford Paving Company, Washington, D. C., $1.29; J. B. Stubbs, Kensington, Md., $1.33; Fred Drew, Washington, D. C., $1.46 and Lyons Brothers, Brookland, D. C., $1.50. Class 2, sidewalks, including cut or fill of 1 ft., with guarantee for 5 yrs., 10 per cent of cost of entire work being withheld for that period, for which an alternate bid was permitted: Rosser & Castoe, $1.14; Brennan Construction Company, $1.24; Cranford Paving Company, $1.35; J. B. Stubbs, $1.33; Fred Drew, $1.48, and Lyons Brothers, $1.66.

SEWERS.

Buffalo, N. Y.—Special—The taxpayers of South Buffalo threaten an injunction suit if the proposed trunk sewer in Abbott-road, Hopkins, Bertha, Germania and Tifft-sts. is constructed.

CONTEMPLATED WORK.

Alliance, O.—A sewer in an alley is proposed. O. U. Walker, Mayor.

Clarksville, Ia.—The construction of a sewerage system is contemplated.

Ravenna, O.—This city voted to issue $40,000 for building a trunk sewer.

Manistique, Mich.—A sewer in Cedar-st. is contemplated. Cy. Surv. Simmons.

North Manchester, Ind.—Plans are being prepared for building a sewerage system.

Springfield, O.—Contracts for the sewerage system will probably be let about July 14.

Sonora, Cal.—This city voted to issue $50,000 bonds for permanent street work and sewers.

Oklahoma City, Okla.—Cy. Engr. Burke has submitted estimates for storm drainage for this city.

Lincoln, Ill.—The construction of an intercepting sewer is proposed. Robert M. Berry, City Clerk.

El Paso, Tex.—(Special.)—Edward Kneezel, architect, advises us that he is interested in septic tanks.

Dansville, N. Y.—The question of constructing a complete sewerage system will probably be voted on.

Clinton, Ill.—This city may join the Central in putting in a large sewer at an estimated cost of $20,000.

Akron, O.—Plans and specifications have been prepared for a trunk sewer in South Akron. City Engineer Payne.

Portland, Ore.—An ordinance has been passed for repairing the Tanner Creek sewer. Thomas C. Devlin, City Auditor.

Newport, Ky.—The city engineer has been directed to prepare plans for sewers in various streets and alleys.

Reading, Pa.—Ordinances have been introduced providing for storm water sewers and new house sewer districts.

Memphis, Tenn.—It is believed that the sewerage system of this city will be completed this year. Mayor Williams.

Bayonne, N. J.—Notice of intention has been given for building sewers in certain streets. W. C. Hamilton, City Clerk.

Wyandotte, Mich.—Plans for a sewerage system, both gravity and lifting, are being prepared by Riggs & Sherman, of Toledo.

Buffalo, N. Y.—Special—Ordinances were passed June 20 for constructing sewers in Germain, Merrimac, Virginia and other streets.

Louisville, Ky.—The question of authorizing a public vote on the proposed $3,000,000 bond issue for sewer construction is being considered.

Helena, Ark. — (Special.)—Francis H. Wright, cy. engr., advises us that he is interested as a possible buyer of pumps for land drainage and sewerage.

Buffalo, N. Y.—Special—Plans are to be prepared for a sewer in Page-st. from Hertel-ave. to Race-st. and in Lawn-ave. from Page-st. to 1,000-ft. west.

Chester, Pa.—The employment of expert sanitary engineers to examine the present sewerage system and design a new one is advised by Col. J. A. G. Campbell.

South Haven, Mich.—Special—Plans are being prepared for main sewers, to be built this season, in sewer dist. No. 3, by George S. Pierson, of Kalamazoo.

Bennettsville, S. C.—The freeholders of this city are signing a petition for an election to vote on the issue of bonds for sewerage and water works systems.

Harrisburg, Pa.—The question of borrowing $100,000 for building several large new sewers will be voted on. Vance C. McCormick, mayor; M. B. Cowden, cy. engr.

Kansas City, Mo.—Plans have been submitted to the bd. of pub. wks. for a septic tank sewer system to care for the sewage in the vicinity of Thirty-first-st. and Benton-boulevard.

Mountain Creek, Ala.—Special—Plans for a sewerage and water-works system for the Home for Confederate Veterans are being prepared by P. Byrne, of Birmingham. About 5,000 ft. of sewer pipe will be required.

Chicago, Ill.—The council com. on sts. and alleys decided, June 24, to use cement instead of brick in sewer construction for the big South End conduit. The ordinance for the Ninety-fifth-st. sewer system was passed June 24.

Philadelphia, Pa.—Special—John D. Harris, 6063 Greenway-ave., has been awarded the contract for building about 40,000-lin. ft. of pipe sewer in Doylestown, Pa., and is ready to receive bids for labor and materials of all kinds.

Denver, Colo.—The bd. of pub. wks. has decided to build sewers to drain all the city south of City Park and north of Fairmount Cemetery now lying outside of the present sewer districts. The work is estimated at $200,000 to $300,000.

CONTRACTS TO BE LET.

New York City—Bids are asked until July 6 for building 2 sewers, William Dalton, comr. pub. wks.

Muncie, Ind.—Bids are asked until July 11 for building several sewers. R. G. Hickok, cy. engr.

Elkhart, Ind.—Sealed bids are asked until July 6 for building a sewer. E. V. Anderson, cy clk.

Des Moines, Ia.—Sealed bids are asked until July 14 for a sewer in Filmore-st. W. W. Wise, chairman B. P. W.

Wheaton, Minn.—Bids are asked until July 11 for digging and cleaning about 2 miles of State ditch, Co. audt.

Marshall, Tex.—Bids are asked until July 12 for constructing sewage disposal works. H. S. Rice, secy. city.

Lawrence, Kas.—Sealed bids are asked until July 4 for building a sewer in an alley. Samuel P. Moore, cy. clk.

Grand Forks, N. D.—Bids are asked until July 5 for building about 1,200 ft. of pipe sewer. F. A. Brown, cy. audt.

Independence, Ia.—Sealed bids are asked until July 12 for building a sewer. A T. O'Brien, chmn. com. on sewers.

Washington, D. C.—Sealed bids are asked until July 9 for constructing sew-

ers. H. B. F. MacFarland, chmn. District Comrs.

Mitchell, S. D.—Sealed bids are asked until July 5 for building a sewer on Main-st. J. G. Markham, cy. audt.

Ashland, Wis.—Sealed bids are asked until July 11 for building sewers in an alley and 19th-ave. A. D. McDonald, chm. B. P. W.

Mishawaka, Ind.—Bids are asked until July 18 for building a vitrified pipe sewer. Horace G. Eggleston, cy. clk.

Davenport, Ia.—Sealed bids are asked until July 5 for building sewer in Taylor-st. and Clay-st. Thos. Murray, cy. engr.

Fremont, Mich.—Bids for building sewers will be received July 5. Geo. S. Pierson, cons. engr., Kalamazoo, Mich.

Galt, Ont.—Sealed bids are asked until July 6 for constructing 10,500 lin. ft. trunk sewers. Joseph McCartney, town clk.

Elmwood Place, O.—Sealed bids are asked until July 20 for building a sewer in Linden-st. H. G. Schaefer, vil. clk.

Cincinnati, O.—Sealed bids are asked until July 13 for building a stone sewer in Glenway-ave. Geo. F. Holmes, clk. B. P. S

Ottawa, O.—Sealed bids are asked until July 20 for drain tile, sewer pipe and catch basins. O. C. Talbot, co. surv. and engr.

Joliet, Ill.—Sealed bids are asked until July 5 for sewers in Third-ave. and Hickory-st. Homer Mooney, clk. bd. local impvts.

Omaha, Neb.—Sealed bids are asked until July 8 for constructing the Saddle Creek disposal plant. Andrew Rosewater, chmn. B. P. W.

Cleveland, O.—Sealed bids are asked until July 6 for sewers in Kenneth and Pennington-sts. W. J. Springborn, prest. B. P. S

Creston, Ia.—Sealed bids are asked until July 4 for constructing a sewer through certain streets. J. C. Sullivan, mayor; W. H. Robb, cy. clk.

Muskegon, Mich.—Sealed bids are asked until July 5 for building 6,300 feet of pipe sewers and accessories. Robert W. Rutherford, vil. clk.

Great Falls, Mont.—Sealed bids are asked until July 11 for constructing 1,720 feet of sewer, 3 manholes and 1 flush tank. J. E. Moran, cy. clk.

Pontiac, Mich.—Sealed bids are asked until July 27 for building 1,190-ft. of sewer in Wesson-st. and 1,415-ft. of sewer in S. Saginaw-st. Wm. J. Fisher, cy. engr.

Chicago, Ill.—Sealed bids are asked until Aug. 24 for deepening about 2,000-ft. of the West Fork of the South branch of Chicago river. Zina R. Carter, prest. bd. trustees.

Saugerties, N. Y.—Sealed bids are asked until July 7 for constructing sewage disposal works and a portion of a sewerage system. R. B. Overbaugh, secy. bd. sewer comrs.

Richmond, Ind.—Sealed bids are asked until July 4 for constructing a lateral sewer; also for a sewer on North West-st. and certain alleys. J. F. Taggart, cy. clk.

New Orleans, La.—Sealed bids are asked until July 7 for masonry and timber drainage construction and sewage pumping stations and foundations. F. S. Shields, secy. sewerage bd.

Boise City, Idaho.—Sealed bids are asked until 4 p. m. July 14 for constructing 3,732-lin. ft 4-ft. and 1,150-ft. 3-ft. brick and concrete sewer, or 1,150-ft. 3-ft. vitrified pipe sewer; 25,378-ft. 30, 27, 24, 21, 18, 15, 12, 10, 8 and 6-in. vitrified pipe sewer; 60-cu. yds. embankment; in four divisions and bids will be received separately or on the whole. H. W. Clement, cy. clk.

CONTRACTS AWARDED.

Toledo, O.—The contract for building 2 sewers was awarded to John McMahon, June 19.

Hillsdale, Mich.—The contract for a sewer was awarded to Louis Jagnaw of Jackson, Mich.

Springfield, Ill.—The contract for a sewer in Glenwood-ave. was awarded, June 17, to W. A. Crumley.

Evanston, Ill.—James Wigginton was awarded the contracts for constructing sewers in 9 streets.

Harrisburg, Pa.—Geo. B. Stucker submitted the lowest bid, June 15, for a new sewer in Cumberland-st., at $8,346.

Pittsburg, Pa.—Sewer contracts were awarded, June 6, to Wm. Molamphy, F. Diulus Bros., and Henry Kreiling & Son.

Algona, Ia.—The contract for building the South Side sewer was awarded to M. Tschirgi of Dubuque for $1,881.

Chester, Pa.—Martin Bunyea was awarded the contract for building sewers on Fourth, Townsend, Canal and Hinkson-sts.

Grand Rapids, Mich.—The contract for sewers in N. Union, Marrian and Earldon-sts. was awarded to Peter Van Ess.

Austin, Minn.—The contract for a sewer on Railway, Elm and Vine-sts. was awarded to Cipra, Shubert & Looman for $3,110.

Long Island City, N. Y.—Sewer contracts have been awarded to Place Bros., John Horle and the Queens Borough Const. Co.

Cincinnati, O.—McCarthy Bros. secured the contract for building sewers in Hackberry and Moorman-sts. for $8,946.85.

Buffalo, N. Y.—Special.—The lowest bidder for a concrete and brick sewer in Virginia-st. was Wm. Franklin at $68,-500.

Lexington, Ky.—Dolan & Sons have been awarded the contract for building sewers in E. High and Maxwell-sts. and Arlington-ave.

Omaha, Neb.—The contract for a section of the Saddle Creek sewer was awarded June 3 to Jas. P. Connolly at $1.34 a lin. ft.

Cincinnati, O.—Sewer contracts have been awarded as follows: Harriet, Eighth and Donnersberger-sts., McCarthy Bros.,

$2,613.20; Eighth-st., Henry Frank, $1,163.-35.

Centralia, Ill.—The contract for sewer construction was awarded, June 20, to D. W. Norton & Co. of Terre Haute, Ind., for $36,427.80.

Hyattsville, Md.—The contract for building a system of sewers was awarded June 2 to Harry A. Miller of Wilmington, Del., for $27,106.26.

Washington, D. C.—The contract for a new cast iron sewerage system for the treasury was awarded June 15 to James F. Nolan & Sons, city, for $25,436.

Plainfield, N. J.—Stone & Grosscart of Philadelphia secured the contract for extending the present sewerage system in the eastern part of the city for $7,166.30.

Ardmore, Pa.—The contract for building two pumping stations, two offices and the concrete collecting basins for Lower Merion twp. has been awarded to Edward Fay of Philadelphia.

Belleville, Ill.—Special—Henry F Merker, cy. engr., says that the contract for constructing sewers in Illinoils, B. Spring and C.-sts. was awarded June 14 to Sweeney & Coonan of East St. Louis, Ill., for $8,868.80.

Centerville, Ia.—Special—The contract for constructing a sewerage system was awarded June 1 to the Baris-Basley Company of Council Bluffs for $52,433.36; disposal plant, Jones & Roderick, Canron, S. D., $15,627.

Rockford, Ill.—Sewer extension contracts were awarded June 14 as follows: S. Gregory, Sixth-ave., $5,567.65; Giacomo Maffioli, Horsman-st., $587.75; N. First-st., $607; S. Fifth-st., $396.30; W. State-st., $511; S. Vandewalker of Belvidere, N. Fifth-st., $608.10, and Longwood-st., $2,410.

WATER-WORKS.

Valparaiso, Ind. — The Valparaiso City Water Company has sold its plant to the Valparaiso Home Water Company for $95,600. The new company agrees, after a period of twenty years, to turn it over to the city.

CONTEMPLATED WORK.

Hopewell, N. J.—Plans are being prepared for water works at this place.

Traverse City, Mich.—This city voted to issue bonds to extend the water mains.

Pittsburg, Pa.—Plans are being prepared and contracts will be let soon for water meters.

Idaho Springs, Colo.—This city voted to issue $75,000 for rebuilding the water works system.

Haddonfield, N. J.—The question of installing municipal water and light plants is being agitated.

Dunkirk, N. Y.—The extension of the water mains in Eagle, Deer and other streets is contemplated.

Niagara Falls, N. Y.—Cy. Engr. McColloh has been directed to prepare plans for a municipal water works plant.

Mobile, Ala.—A resolution has been passed providing for an appropriation of $15,000 for an auxiliary pump.

Pittsburg, Pa.—The question of issuing bonds for $5,000,000 for a filtration system will be voted on July 12.

La Crosse, Wis.—The Board of Public Works will recommend the construction of a filtration plant at a cost of about $125,000.

Tacoma, Wash.—Mayor George P. Wright and comr. pub. wks. Welsh are devising a plan for installing a water works system.

Toledo, O.—An issue of $500,000 bonds for the addition of a purification plant to the present water works system is favored.

Hamilton, O.—A new water supply and the removal of the present pumping station at the Miami River is suggested by Mayor Bosch.

Lorain, O.—The question of issuing bonds for the improvement and extension of the water works system will be voted on July 12.

Lewiston, Mont.—A second pump will probably be installed at the water works as a precautionary matter, by the city council.

Logansport, Ind.—The Logansport Pure Water Co. has been incorporated and will construct filter beds to supply pure water to the city.

Lima, O.—Bids will probably be opened about July 15 for the proposed additional water supply for this city. J. H. Morrison, dir. B. P. S.

Ashland, Ky.—Special.—W. A. Patton, mgr. of the Ashland Water Works Co., advises us that they are in the market for pulsometer pumps.

New York City—Maps and plans have been submitted to the bd. of est. by Comr. Oakley for 2 salt water pumping stations in the borough of Brooklyn.

St. Louis, Mo.—Special.—C. Blackwell, 911 Lincoln Trust Bldg., advises us that he is interested in the purchase of electrically driven and steam pumps.

Cleveland, O.—City coun. declined, by unanimous vote, June 20, to cut the appropriation for water works from $114,000 to $14,000, as had been suggested.

Grand Rapids, Mich.—Mayor Sweet contemplates reviving the question of a pure water plan. The bd. of pub. wks. has decided to install meters as rapidly as it is convenient.

Bangor, Me.—A committee, consisting of the mayor, city engineer, two aldermen and others has been appointed to investigate the city water supply with a view to obtaining a better one.

Cambridge, Mass.—The finance com. of council will recommend the adoption of an order appropriating $250,000 for constructing the first section of the pipe line from Hobbs Brook to Fresh Pond.

The question of issuing bonds for the construction of water works will be voted on at the following places: Bennettsville, S. C.; Troy, Idaho, July 11; Leesburg, Va., July 9; Thamesville, Ont., July 11.

Kansas City, Mo.—The contract entered into by the R. J. & W. M. Boyd Construction Company to lay a 48-in. steel water flow line has been rescinded because the right-of-way has not yet been established.

Mountain Creek, Ala.—Special.—Plans for a water works system, consisting of an 80,000 gal. pumping basin, thirty horsepower boiler, 50,000 gal. pump, tower and tank, and 5,000 ft. of cast iron pipe and eight fire hydrants, are being prepared by P. Byrne, consc. engr. of Birmingham, for the Home for Confederate Veterans.

Magnolia, Miss.—The contract for preparing plans and specifications for a new water works system has been let to X. A. Kramer & Co., and bids for construction will be asked as soon as they are completed.

The question of issuing bonds for the construction of water works has been favorably voted on at the following places: Utica, Mich.; Wilton, N. H. Atwater, Minn.; Belle Plaine, Ia.; Aberdeen, Miss.; North Freedom, Wis.

The construction of water works systems is contemplated at the following places: Dexter, N. Y.; Anita, Ia.; Fulton, S. D.; Ringstead, Ia.; Spooner, Wis.; North Vancouver, B. C.; Fredericktown, O.; Sherodsville, O.; Salem, O.; Lake Nebegamon, Wis.; Nashwauk, Minn.; Kennard, Neb.; Roseland, Neb.; El Dorado, Ark.

Bessemer, Ala.—Special—P. Byrne, cons. engr., of Birmingham, is preparing plans for an extension of the Bessemer Water Works Company plant at an estimated cost of $60,000. The pumping station located at Hawkins Springs, will have two 1,500,000 gal. pumps; 11,137 feet of 16" cast iron pipe to a 5,000,000 gal. reservoir; 17,888 feet of 14" cast iron pipe to Bessemer. Extensions will also be made to street mains and additional fire hydrants placed. Contracts will be made for material as above. The company will do the construction work.

CONTRACTS TO BE LET.

Kasson, Minn.—Bids are asked until July 5 for the extension of the water mains. S. Goodrich, recorder.

Colfax, Wash.—The time for receiving bids for a filter system has been postponed from June 6 to July 5.

Libertyville, Ill.—Bids are asked until July 10 for constructing a water works system. Frank Kern, vil. clk.

Ft. Moultrie, S. C.—Sealed bids are asked until July 11 for sinking a deep 6-in. tubular well. F. L. Buck, Q. M.

Mora, Minn.—Sealed bids are asked until July 8 for constructing a complete water works system. D. R. Eaton, prest. coun.

Jefferson, Tex.—Sealed bids are asked until July 5 for constructing a water works system. J. H. Rowell, sr., mayor.

Litchfield, Minn.—Bids are asked until July 4 for laying 1,344-ft. of water mains on Sibley-ave. and 500-ft. on Swift-ave.

La Salle, Ill.—Sealed bids are asked until July 5 for erecting a boiler house at the water works. F. J. Pierard, cy. clk.

Montreal, Que.—Sealed bids are asked until July 5 for furnishing cast iron pipes, special castings, brass castings, etc. L. O. David, cy. clk.

Washington, D. C.—Bids are asked until July 23 for furnishing c. i. pipe and specials for siphons. H. B. F. MacFarland, chm. District Comrs.

Binghamton, N. Y.—Sealed bids are asked until July 7 for constructing a concrete river protection wall. John Anderson, secy. and supt. bd. water comrs.

Mansfield, O.—Bids are asked until July 6 for constructing a water supply reservoir, including 6,000 cu. yds. of excavation and 1,600 cu. yds. of concrete lining. B. P. S.

Tiffin, O.—Bids are asked until July 18 for a franchise to construct and maintain a water works system and to furnish this city with water for a term of twenty yrs. John E. Diemer, cy. audt.

San Diego, Cal.—Sealed bids are asked until July 14 for furnishing 11,822 lengths of c. i. pipe, 46 cantilever towers, 176 steel brents for trestles, 455 rims and covers for manholes and 251 lengths of Kalemein pipe. F. H. Dixon, secy. B. P. W.

CONTRACTS AWARDED.

Rocky River, O.—A franchise has been granted Chas. P. Corlett for installing a water works plant here.

Carrollton, Miss.—The contract for water works was awarded to F. H. Porter of Clinton, Ky., for $11,000.

Boone, Ia.—The contract for constructing a water works system at the county farm was awarded to C. B. Sherman & Co.

Tishomingo, Ind. Ter.—Taylor & Moore of Houston, Tex., secured the contract for constructing the water works system for $26,900.

Hudson, N. Y.—The contract for constructing a water works system was awarded, July 11, to Hurd, Sherman & Co., for about $300,000.

Quarryville, Pa.—The contract for improving the plant of the Quarryville Water Company's plant has been awarded to Wm. G. Fritz of Dover N. J.

Lynchburg, Va.—The contract for constructing the new gravity water works system was awarded, June 4, to Chauncey G. Williams of Brooklyn for $499,360.96.

Seattle, Wash.—The contract for furnishing 19,500 ft. of 16-in. water pipe was awarded, June 11, to the Washington Pipe & Foundry Company of Tacoma for about $52,000.

Caldwell, N. J.—The contract for the extension of the water mains in certain streets has been awarded as follows: Piping, Warren Foundry Company; hydrants, Eddy Valve Company; valves, Darling Pump Manufacturing Company; laying mains, Robt. W. Smith.

Buffalo, N. Y.—Special—Contracts for furnishing supplies have been recommended as follows: C. i. pipe and special castings, United States Iron Pipe & Foundry Company, $24 per ton; valves,

service boxes, manholes, frames and covers, and vault covers, Bingham & Taylor, Buffalo; hydrants, Howard Iron Works, Buffalo; corporation cocks, plugs, etc., A. P. Smith Manufacturing Company, Newark, N. J.

BRIDGES.

Ionia, Mich.—The construction of a bridge across Grand River is contemplated.

Rockport, Ind.—Bids are asked until July 5 for erecting 2 concrete bridges. Bd. co. comrs.

Youngstown, O.—Bids will be received until July 12 for construcing the Carson bridge. Co. comrs.

Bloomfield, Ind.—Bids are asked until July 6 for building several bridges. W. H. Deckard, co. audt.

Fargo, N. D.—Sealed bids are asked until July 7 for building several bridges. Arthur G. Lewis, co. audt.

Rising Sun, Ind.—Bids are asked until July 4 for a bridge over Arnold's Creek Jas. W. Carson, co. audt.

Ashland, O.—Sealed bids are asked until July 6 for constructing 8 steel bridges. E. B. Westover, co. audt.

Pecatonica, Ill.—Bids are asked until July 5 for building an iron bridge. W. R Winchester, cy. clk.

Sioux City, Ia.—City Engineer Lewis is preparing plans and specifications for a bridge over Perry Creek on Third-st.

Moscow, Idaho—Bids are asked until July 21 for building bridges throughout the county. A. T. Ramstedt, co. clk.

Noblesville, Ind.—Bids are asked until July 16 for building a bridge over Williams creek. H. Y. Findley, engr.

Resort, N. Y.—Bids are asked until July 5 for a bridge across Great Sodus Bay. Henry A. Van Alstyne, State engr., Albany.

Elkhart, Ind.—Bids are asked until July 7 for building 7 stone arch bridges and 2 steel bridges. O. H. Sweitzer, co. audt.

Vicksburg, Miss.—Sealed bids are asked until July 4 for building a wooden bridge at Bazsinsky-place. J. D. Laughlin, co. clk.

Aquilla, Mo.—Bids are asked until July 5 for raising the steel bridge and putting new sills under the ends. A. C. Spiker, comr.

Sobieski, Wis.—Bids are asked until July 31 for constructing a concrete highway bridge across Little Suamico river. J. J. Hof.

Helena, Ark.—Special.—Francis H. Wright, cy. engr., advises us that he is interested as a buyer in a short span street bridge.

Richmond, Ind.—Bids will be received until July 6 for building the approaches to the West river bridge in Jackson twp. Bd. co. comrs.

Chicago, Ill.—Sealed bids are asked until July 20 for building four riveted steel highway bridges over the Illinois and Mississippi Canal. C. S. Richie, capt. engrs.

Madison, Ind.—Bids are asked until July 5 for bridge work including masonry, fills and new steel bridges. G. F. Crozier, co. audt.

South Bend, Ind.—Bids are asked until July 6 for constructing a steel bridge and concrete arch in Center twp. John W. Harbon, co. audt.

Topeka, Kas.—The City Railway Company is having plans prepared for a permanent steel bridge across the river on Kansas-ave. Frank Kelly, secy.

Buffalo, N. Y.—Special—Bids will be asked soon for the construction of a new bascule bridge at Ohio-st. over the Buffalo River. B. P. W

Meridian, Miss.—Sealed bids are asked until July 4 for building a wooden span to the bridge across Oktibbeha Creek. B. V. White, clk. bd. supvrs.

Mission, Wash.—Bids are asked until July 6 for constructing a bridge across Wenatchee River, about 4-mls from this city. C. J. Trow, co. audt.

Pensacola, Fla.—Bids are asked until July 11 for removing the old bridge across Bayou Texar and taking up the piling. A. M. McMillan, clk. bd. co. comrs.

Marshall, Ill.—Sealed bids are asked until July 5 for building two bridges and stone abutments therefor. A Veach, chmn. joint com.; John Hazen, town clk.

Elk River, Minn.—The village council has decided to call a special election to vote on the issue of bonds for building a bridge across the Mississippi River.

Laporte, Ind.—Bids are asked until July 6 for constructing an iron bridge and mill gate at Hanson's Mill in Springfield twp. Chas. H. Miller, co. audt.

Brookville, Ind.—Sealed bids are asked until July 5 for constructing a monolithic concrete bridge across the creek on the State-road in Oldenburg. Bd. co. comrs.

Cleveland, O.—Sealed bids are asked until July 6 for concrete masonry and steel bridge in Orange twp.; stone masonry and steel bridge in Olmstead Falls village. Julius Dorn, clk.

Atlanta, Ga.—The contract for building the new abutments to the new bridge over the Southern R. R. on Edgewood-ave. was awarded to the Baltimore Ferro-Concrete Company for $12,460.

Harrisburg, Pa.—Sealed bids are asked until July 5 for rebuilding the substructures and superstructures of a large number of bridges. J. M. Shumaker, supt. bd. comrs. public grounds and bldgs.

Scranton, Pa.—Sealed bids are asked until July 5 for rebuilding the substructure and superstructure of a bridge over the Lackawanna River at Blakely borough. J. M. Shumaker, supt. public grounds and bldgs.

El Dorado, Kas.—Sealed bids are asked until July 7 for repairing and rebuilding a low truss bridge; also, building a new 40-ft. span truss bridge on stone piers

at the same place. H. A. J. Coppins, co clk.

Fon du Lac, Wis.—Sealed bids are asked until July 6 for removing the present bridge across the west branch of Fond du Lac River, remodeling the abutments and building a new bridge. F. A. Bartlett, cy clk.

Columbus, O. — Sealed bids are asked until July 19 for building substructures, superstructures, approaches, retaining walls and other work connected with a number of bridges. John Scott, clk. bd. co. comrs.

Boston, Mass.—The Boston and Cambridge, Commission has directed City Engineer Jackson to prepare plans for a high level bridge at Essex-st, New Cottage Farms; a high and low level bridge over Charles River, New Soldiers' Field.

Albion, Ind.—Sealed bids are asked until July 5 for erecting a girder leg bridge with concrete backing across Boyd Ditch, Elkhart Twp.; also a concrete arch across a public ditch in Green Twp. John L. Henry, co. audt.

STREET LIGHTING.

Whitehall, Mich.—This village voted to enlarge the electric light plant.

McKinney, Tex.—This city voted to issue $8,000 bonds for installing an electric light plant.

Ithaca, Mich.—This village voted to issue $13,000 bonds for building an electric light plant.

New Albany, Miss.—The question of issuing bonds for an electric light plant will be voted on.

LaGrange, Ga.—The question of establishing a municipal electric lighting system may be voted on.

Newport, Ky.—The question of municipal ownership of an electric light plant will be voted on this fall.

Thomson, Ga.—This town will vote, July 13, on the question of issuing bonds for an electric light plant.

Webster City, Ia.—The question of giving a franchise for a gas plant to M E. Springer will be voted on July 18.

Little Rock, Ark.—The establishment of a gas and electric light plant is proposed at North Little Rock. Mayor Faucette.

Newburgh Heights, O.—Sealed bids are asked until July 12 for supplying this village with street lights. H. H. Bohning, clk.

Plattsburg, N. Y.—Bids are asked until July 15 for lighting the streets for 5 yrs. with electricity. W. J. McCaffrey, mayor.

Saginaw, Mich.—City Engr. Roberts has engaged W. A. Markey to assist him in making plans for a municipal electric light plant.

Summerville, S. C.—A franchise has been awarded to the Summerville Electric Light & Power Co. to install an electric light system.

Lancaster, S. C.—Aldermen Carter and Lazenby have been appointed a committee to ascertain the cost of an electric light plant for this place.

Lockport, N. Y.—The bd. of aldermen has awarded a contract to the Lockport Gas & Electric Light Co. at $75 per arc light and $17.50 per gas lamp.

Marion, Ill.—Special.—James A. Crane & Co., archs. and engrs., advise us that they are interested as possible buyers of a complete gas plant for this city.

Newberry, S. C.—The comrs. of pub. wks. have recommended that the power house be equipped with a new engine and electrical apparatus, for the purpose of having more light.

Watkins, N. Y.—Bids will be received until July 20 for $20,000 bonds for constructing an electric or other improved lighting system. George Haring, chmn. bd. water and sewer comrs.

New Orleans, La.—Bids are asked until Aug. 15 for furnishing and erecting 2 gas producer plants for supplying gas to gas engines, and making additions to transmission line and switchboard. F. S. Shields, secy.

Newton Falls, O.—A 10-yr. lighting contract for lighting this village with electricity has been awarded to E. E. Mandeville of Philadelphia, who will build and equip the plant and furnish 16 arc lights at $70 per lamp per year. A 20-yr. franchise for commercial lighting and furnishing power was also put into effect.

FIRE APPARATUS.

Montreal, Que.—Bids are asked until July 7 for 2 steam fire engines. L. O David, cy. clk.

Camden, N. J.—An ordinance has been passed authorizing the issue of $25,000 bonds for the purpose of purchasing steam fire engines and apparatus. H. C. Kramer, cy. clk.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

McKeesport, Pa.—The contract for a new garbage furnace was awarded to the Clinton Furnace Co., of New York City, for $12,077.

Allegheny, Pa.—An ordinance has been approved to let the contract for the removal of garbage from this city for a period of two years at an annual cost of $28,000.

Fort D. A. Russell, Wyo.—(Special.)—W. S. Scott, Captain and Quartermaster U. S. A., says that bids for constructing a crematory at this place were opened June 14, the bids being as follows: Charles F. Hendrie, Denver, Col., $8,200; Dixon Garbage Company, Toledo, O., $9,995; Municipal Engineering Company, New York City, $9,500.